

# STRIVE

## Report Series No.84

# Study of Pay-by-use Systems for Maximising Waste Reduction Behaviour in Ireland

## STRIVE

Environmental Protection  
Agency Programme

2007-2013

# Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.

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- Office of Environmental Assessment
- Office of Communications and Corporate Services

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**EPA STRIVE Programme 2007–2013**

# **Study of Pay-by-use Systems for Maximising Waste Reduction Behaviour in Ireland**

Development of Optimised Pay-by-use Systems which are  
Designed to Maximise the Incentives for Waste Reduction  
while at the same time Maintaining a Properly Functioning  
Waste Management System

**(2008-WRM-MS-6-S)**

## **STRIVE Report**

Prepared for the Environmental Protection Agency

by

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# Executive summary

## Background

This study aimed to evaluate pay-by-use (PBU) domestic waste collection systems in Ireland in terms of their impacts upon waste disposal, recycling, and, in particular, waste prevention, in order to determine the most effective system or system components for maximising waste reduction behaviour. In addition, the study examined the attitudes of waste collectors and householders to PBU waste charges generally, and to their own individual systems, with the overall research goal of identifying and recommending optimised PBU domestic waste charging systems for Ireland. The research was carried out in 2009 and 2010.

Information was gathered from all the 15 local authorities that collected domestic waste in 2009, using a survey and follow-up interviews and from 18 of the 80 private collectors operating in Ireland. To increase the private collector representation, the research team also gathered the 2008 *Annual Environmental Reports* (AERs) for other private domestic waste collectors. Data sets were used from 48 private collection schemes all over Ireland, servicing 298,848 households and from 14 local authority collection schemes, servicing 494,003 householders. In all, 62 data sets accounting for 792,851 households (over 50% of all households in Ireland) were used for analysis.

To analyse the attitudes of householders, the company Red C interviewed 1,000 people as part of their omnibus service (of which 790 were responsible for their households' waste management). The sample was quota controlled and weighted to the known national population data from the Central Statistics Office (CSO) 2006 census. Therefore, those surveyed were representative of the Irish population in terms of geographical location, age, gender and social class.

## Pay-by-use

Pay-by-use applies the concept that people should pay waste collection charges that relate to the amount and type of the waste being collected and managed. From

1<sup>st</sup> January 2005, all local authorities in Ireland were required to implement a pay-by-use charging system for domestic waste, as were private waste collectors whose permits needed to be renewed by the local authority.

PBU has been implemented in other countries for many years. It has been prevalent in the USA since the 1970s and has also grown across Europe, with municipalities in Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, The Netherlands, Norway, Sweden and Switzerland all implementing user-charges. Several other countries have also implemented these charges, including in New Zealand, and Taiwan, and by 1995 South Korea had introduced PBU to all municipalities nationwide. The project team also analysed data and reports from many of these regions, in order to find out the impacts that PBU systems have had on household waste behaviour outside of Ireland.

## Pay-by-use systems in Ireland

All waste collectors in Ireland have now adopted PBU charges and the research shows that householders have a very good opinion of the system and feel that it has led to an improvement in their waste management behaviour - reducing their waste and increasing recycling levels. However, the charges have been implemented in different forms across the country with several different PBU systems in place – both publicly (local authority) and privately run.

Weight-based systems (including the 'per-kilogramme', banded and average weight systems) allow the user to pay an amount relating to the weight of waste they produce. Tag-based systems (including tag-a-bin, tag-a-bag and pay-per-lift systems) allow the user to either purchase and place a tag on the bin or bag, facilitating collection, or else pay for each time the bin is lifted (using a chip on the bin which records it). The differential bin size charging system charges households a flat fee based on the residual bin size they select to use; e.g. the annual charge for a 240 litre residual bin will be more expensive than the charge for a 140 litre residual

bin. Once the annual charge is paid, the householder can present their bin as often as they like, with as much waste as they like, without incurring any additional cost.

The national household survey carried out as part of this study indicated that 46% of households in Ireland say they use differential bin-based charges, 34% say they use tag-based charges and 20% say they use weight based charges.

Approximately 53% of households surveyed said that their waste collectors are private companies and 47% are local authorities. But the data show a continuing growth in domestic collection from private collectors and that numbers of local authority customers are decreasing, with some local authorities withdrawing from collection of domestic waste at all. At the beginning of the research in 2009 there were 15 local authorities, but by 2011 this is expected to be 12 or less.

The survey indicated that 13% of the respondents do not have a waste collection service for their homes. Of these, 69% of households selected not to have a service and 31% (4.0% overall nationally - 31% of 13%) live in an area without a waste collector operating.

Acceptance levels of PBU were high nationally. Prior to the introduction of PBU charges, 62% of respondents were in favour of the charges and 23% were against the charges. Following the introduction of PBU, 72% were in favour and only 18% were against. A high percentage of householders also indicated that PBU charges influence their waste management behaviour favourably. Eighty three percent of respondents agreed strongly with the statement 'PBU charges encourage me to recycle', with only 7% disagreeing with this statement. Sixty two percent of respondents agreed strongly and 18% agreed slightly that PBU charges encouraged them to reduce their overall waste production.

## Optimised Systems

From the research and examination of the many quantitative and qualitative data received, the 'per kilogramme' weight-based system, and the 'pay-per-lift' tag-based system are the most favourable pay-by-use systems for domestic waste collection in Ireland. These PBU systems can also provide three major components for optimisation: pre-service billing, a reliable automated

system and good data provision. They have led to significantly reduced waste volumes being presented by households and higher diversion rates from landfill. They are also acceptable to the public and have led to a greater influence on awareness levels and behavioural change than other systems. This reflects experiences in other countries that have also introduced pay-by-use.

**Weight-based charges** are the single most effective PBU system. These charges have prompted the highest per household recycling levels (between 27% and 32%), highest diversion rates from landfill (between 28% and 35%) and the lowest total kerbside waste figures (between 800kg and 947kg per annum). If the estimated 80% of those households across Ireland currently on tag and differential bin systems switched to 'per kg' based PBU systems, it could lead to an annual diversion from landfill of approximately 446,000 tonnes of domestic waste per annum.

Pay-by-weight gathers accurate data on weights and frequency of presentation, which enable waste collectors to plan their collection more efficiently. In addition, weight-based charges do not encourage waste compaction in the bins, which can be a problem for some tag-based systems. The main disadvantage of weight-based charges is the expense involved in setting up the system. However, several collectors stated that the system is not expensive to run following the initial set-up costs. Another significant problem has been the use of post-service billing, which can lead to arrears (which are difficult and expensive to pursue). This problem can be overcome by the use of an advance payment system. Furthermore, households with weight-based charges present their bin frequently, even when not full, pushing up waste collection costs for collectors. The use of a lift charge alongside the weight charge can remove this problem.

Households using a weight-based system felt that their PBU charge had a large impact on their waste management behaviour, including recycling levels and waste reduction. In addition, weight-based households expressed high levels of acceptance of PBU domestic waste charges.

**Tag-based PBU waste charges** can also be effective. Average recycling rates for tag-based charges (20%) are lower than those for overall weight-based charges

(27%) and more or less the same as differential bin (21%), but average waste amounts per household are relatively low (928kg per annum). However, there is a large variation in results within tag-based systems, with some collectors achieving results akin to those of weight-based charges, while others achieve results similar to those of differential bin size charges.

Pay-per-lift systems require a large set-up cost, as they use chipped bins and trucks with chip reading technology. In addition, this system involves post-service billing, which may lead to administrative costs in following up unpaid bills. This problem can be overcome by introducing an advance payment credit system, as many collectors are currently selecting to do. Tag-a-bin and tag-a-bag charges do not involve large set-up costs. However, the majority of tag-a-bin collectors questioned felt that there were significant drawbacks with this manual tagging system. The main issues were: the manual nature of the system, a very large administrative burden, difficulties regarding waivers and discount costs, fraud problems, difficulties with the staff collecting the waste and the tags, and a lack of information about their customer base. The low cost and the upfront payment by households are the main advantages of these tag-based charges from the perspective of waste collectors. But the pay-per-lift option is still considered the most attractive of the three.

The households surveyed had high levels of acceptance of tag-based charges, with 80% of households with tag-based systems stating they are in favour of PBU charges. More tag-based households stated that their charges made them aware of the cost of waste disposal than households using other PBU systems.

**The differential bin sized system** was found to be the least effective system in terms of impact upon the environment, resulting in a high waste to landfill rate (79%) and highest total waste of the three PBU systems studied (1,294kg per household per annum).

Differential bin size systems are widely used by private collectors, but at the time of data collection, were being used by only two local authorities. Waste collectors using this charge stated that the advantage of this system is that it is easy and cheap to introduce and administer. The system involves an annual charge, paid at the beginning of the year. This charge is paid in advance of

the service being provided (in a lump sum or monthly/quarterly by direct debit), ensuring a stable income for waste collectors and low administration costs. From the perspective of waste collectors this system appears convenient. But if the system results in large amounts of residual waste being presented by householders, the waste collector will incur the cost of disposing of this at landfill.

Households with this system were less accepting of PBU (67% as compared to 79% for weight-based and 80% for tag-based systems). In addition, households with a differential bin size system felt that the system did not make a large impact upon their waste management behaviour.

## Other Findings

Pay-by-use systems as implemented by local authorities appear to perform better environmentally than those implemented by private collectors (based upon a limited number of data sets). The weight-based systems being implemented by local authorities achieved an average 33% recycling rate and average per household waste of 768kg compared to 24% recycling and total waste of 1,040kg for those implemented by private companies. The tag-based systems implemented by local authorities achieved 21% recycling and household waste of 912kg compared to 16% and 1,192kg for those implemented by private companies.

The waiver of domestic waste charges is a problematic issue, especially for local authorities, and is cited as one of the main reasons that some of them are withdrawing from the market. The numbers of waivers in the different local authority areas varied from 7% to 37% of customers, with an average of about 23% of local authority customers availing of a waiver. In one local authority, 25% of its customers paid no charges at all. These numbers were growing, as the economic recession hit the country. The levels of waivers (types and amounts of reduction in charges) and the criteria for households to receive waivers varied widely. The research indicates that waivers should be available to all those who qualify, whether from public or private collectors and the system should be standardised. However, the burden of these waiver costs should not be borne by the waste collectors alone.

Other problems for local authority collectors relate to VAT, an inability to change rapidly, the introduction of a separate organic waste collection service, bill collection difficulties and people opting out of any waste collection service.

Irish waste policy uncertainty during the research period was a concern stated by almost all waste collectors. Some collectors were unsure whether their role as waste collectors would be able to continue and were awaiting a policy statement on this topic. Many local authorities were pessimistic about their future, with only the larger

authorities showing any optimism and making plans for improvements to their services. On the other hand, the large private collectors appear more confident, but they too are seeking clarity regarding future waste policies before investing.

It should be noted that, following an international review, (Hogg *et al.*, 2009), The Minister for the Environment, Heritage & Local Government published for public consultation a *Draft Statement of Waste Policy* (DoELHG, 2010) towards the end of the research period and this could have alleviated some of these concerns.

# **1 Introduction**

## **1.1 Project Details**

This study aimed to evaluate each pay-by-use (PBU) domestic waste collection system in Ireland in terms of its impacts upon waste disposal, recycling, and, in particular, waste prevention in order to determine the most environmentally effective system or system components. It also examined PBU in other countries in a detailed separate literature review, to compare results in Ireland with those regions. In addition, the study examined the attitudes of waste collectors and householders to PBU waste charges, and the individual PBU systems, with the overall research goal of identifying and recommending optimised PBU domestic waste charging systems for Ireland. In examining the impacts of PBU systems upon the environment, householders, and waste collectors the study analysed the sustainability of each PBU system, using the three pillars of sustainability: (i) environment, (ii) society (i.e. householders), and (iii) economy (i.e. waste collectors).

## **1.2 Outline of the Report**

This report is divided into five sections. Section 1 introduces the project and report, its aims and structure.

Section 2 describes what is meant by PBU systems. It outlines the different types of systems and discusses how they have historically and are currently being applied to householders in Ireland. It describes the policy framework upon which they are being implemented, looking at international experiences and how Ireland relates to them, and outlining the contribution of Ireland's experiences to international knowledge.

Section 3 outlines the methodologies used in the study in relation to waste collectors and householders, and also identifies and discusses the potential sources of data error.

Section 4 describes the impacts of PBU charges in Ireland, on the environment (waste prevention, recycling and landfilling), on the waste collector and on households.

Section 5 states the main findings, conclusions and recommendations from the research.

## **2 Pay-by-use Waste Collection Systems**

### **2.1 What is Pay-by-use?**

Pay-by-use (PBU) applies the concept that people should pay collection charges for their waste that relate to the amount and type of waste being collected and managed. It implements the EU 'Polluter Pays Principle', which states that those who cause environmental damage should bear the costs of avoiding it or compensating for it, and that these costs should relate to the extent and type of the damage caused.

From 1 January 2005, all local authorities in Ireland were required to implement a PBU charging system for domestic waste, as were private waste collectors whose permits required renewal by the local authority. Rising waste levels, the Polluter Pays Principle, a greater focus on waste prevention, higher national recycling targets, and the biowaste targets required under the Landfill Directive (EC, 1999) motivated the adoption of PBU domestic waste collection charges.

The actual model to be used was left to the discretion of the local authorities and private collectors. The rationale for this, as distinct from applying a prescriptive 'one-fits-all' approach, was based on the following considerations:

- 1 A prescriptive approach could be anti-competitive and ultimately lead to higher consumer charges than would be the case where service providers have freedom to develop the most efficient solution for their market and given their structure, technology, etc.
- 2 A prescriptive approach might militate against the development of potential innovative approaches, particularly as it remained to be seen which system optimally achieves the combined objectives of maximising landfill diversion while minimising costs on households.

Waste collectors nationwide have since adopted the PBU charges. However, these charges have been implemented in different forms across the country with several different PBU systems (weight, tag, and differential bin size systems) used – both public and privately run. These are described below.

#### **2.1.1 Weight**

The weight-based system grouping includes three pay-by-weight systems currently used in Ireland.

- The 'per kilogramme' system involves the use of a charge per kilogramme (kg) of municipal solid waste (MSW) placed out for collection in wheelie bins, in addition to an annual flat-rate service charge. When an MSW bin is lifted, the weight of the bin is recorded and the householder is later issued with a bill that includes a portion of the service charge and the charge for the weight of waste presented by the householders.
- The 'banded' weight-based system uses several weight brackets that an annual bin weight may fall within, with a different price for each weight bracket.
- The 'average weight' weight-based system uses a calculated average household waste presentation rate (commonly 800kg per year). If a household produces less weight than this average they receive a reduction on their next annual bill and if a household produces more weight than this average they are billed for the additional weight.

#### **2.1.2 Tag**

The tag-based system grouping encompasses three PBU systems: (i) tag-a-bin, (ii) pay-per-lift and (iii) tag-a-bag. All three systems work on the same principle: the household pays directly for the volume of waste they present, whether within a bin or a bag. Therefore, these three systems have been grouped together under the category of 'tag-based PBU charges' for the purposes of the analysis.

- The tag-a-bin system involves the purchase of tags that are then attached to the MSW bin; bins without a tag are not collected. Bin tags vary in price according to the size of the bin used by the householder, with tags for larger bins costing more than tags for smaller bins.
- In some cases, bin tags are also required for the dry recyclable fraction (DRF) and separated organic fraction bins. However, the cost of tags for these bins is lower than for MSW bin tags in order to incentivise waste diversion from landfill.

- The pay-per-lift system involves a chipped bin recording the number of times it is lifted for collection and the household then receiving a regular bill charging them per bin lift.
- Finally, the tag-a-bag system involves the purchase of a tag or sticker that is attached to a bag of waste allowing it to be collected.

### 2.1.3 Differential Bin

The differential bin size charging system charges households a flat fee based on the residual bin size they select to use. For example, the annual charge for a 240-litre residual bin will be more expensive than the charge for a 140-litre residual bin. Once the annual charge is paid, the householder can present their bin as often as they like, with as much waste as they like, without incurring any additional cost.

## 2.2 Historical Background to the Introduction of Pay-by-use Domestic Waste Charges

Charging for domestic solid waste collection was abolished in 1977 in Ireland. Subsequent to that, Ireland's local authorities found themselves increasingly short of funds for waste management (Lawlor and Scott, 1997). In 1983 national legislation was passed allowing the authorities to once again levy charges on households for waste collection and disposal services supplied. Despite this, charging was not widespread for many years and the local authorities that chose to levy charges used a flat-rate waste collection fee, with householders paying the same charge regardless of the amount of waste put out for collection. Under a flat fee for waste collection, households face a zero marginal cost to producing more waste and have no incentive to reduce the production of waste or increase the recycling of waste.

In 1997 the policy documents *Sustainable Development – A Strategy for Ireland* (Department of the Environment, Heritage and Local Government [DoEHLG], 1997a) and *Recycling for Ireland* (DoEHLG, 1997b) were published; these were followed in 1998 by *An Action Plan for the Millennium* (Department of an Taoiseach, 1998). These focused on the need for changes to be made in the waste management sector. *Waste Management – Changing our Ways* (DoEHLG, 1998), which was also published in 1998, highlighted the

necessity for a considerable reduction in the amount of waste going to landfill. More recent policy statements on waste (DoEHLG, 2002; DoEHLG, 2004a; DoEHLG, 2004b) focused on introducing economic instruments in line with the Polluter Pays Principle to reduce the rising volume of household waste going to landfill. The 2004 policy document *Waste Management – Taking Stock and Moving Forward* outlined the national plan to introduce domestic PBU charges by 1 January 2005 (DoEHLG, 2004b).

Irish environmental law has legislated for the use of economic instruments since 1992. The Environmental Protection Agency Act, 1992, laid down the Polluter Pays Principle as one of its key values (Government of Ireland, 1992) but until recently this principle was not adhered to in the management of household waste. In national law the Waste Management (Amendment) Act, 2001 (Government of Ireland, 2001) is a key piece of legislation incorporating economic instruments in an attempt to manage the spiralling waste problem. The Waste Management Acts, 1996 and 2001 (Government of Ireland, 1996; Government of Ireland, 2001), which gave responsibility to local authorities to formulate their regional waste management plans, outlined plans to develop laws to limit the recovery or disposal of certain waste streams to certain types of waste facilities and legislated for the landfill levy and plastic bag tax. These levies are ring fenced and go to the Environmental Fund.

The 2003 Protection of the Environment Act gave enhanced powers to local authorities with regard to the enforcement of waste legislation. The legislation established executive powers for local authorities over waste charges and they were granted the right to stop collecting domestic waste if charges are not paid (Government of Ireland, 2003). The waste management legislation brought in by the Act was highly controversial. The right of the local authorities to suspend waste collection from debtors was a large shift from the previous laws outlined in the Waste Management Act, 2001 (Laurence, 2004).

The changes in attitude to domestic waste management expressed in Ireland reflected the movement by the EU to tackle the increasing production of waste. All EU waste management regulations are based on the key principles (including the Polluter Pays Principle) laid down in the 1975 Waste Framework Directive

(European Economic Community [EEC], 1975). In more recent years the Strategy for Waste Management (EEC, 1997) asserts the value of economic instruments as a method of applying the Polluter Pays Principle in waste management and outlines a waste management hierarchy for EU member states. The waste management hierarchy places landfill as the least desirable method of waste disposal, and on this basis all Irish waste policy is focused on redirecting waste streams further up the hierarchy, to options such as prevention, reuse and recycling. Together, the Polluter Pays Principle and the waste hierarchy advocate a diversion of waste from landfill using methods that charge producers of waste according to the amount of waste they create. To this end, in Ireland, on 1 January 2005 flat-rate waste collection charges were required to be replaced with PBU domestic waste collection charges to householders with the aim of reducing the amount of waste produced and sent to landfill, and increasing recycling levels, by the application of the polluter pays principle.

### **2.3 Theoretical Framework behind Pay-by-use Domestic Waste Charges**

PBU domestic-waste pricing charges households per unit of waste placed out for waste collection. A kilogramme of waste, a bag of waste and a bin of waste can all be considered a unit for waste-charging purposes. A household can be charged per kilogramme, per bag or per bin of waste collected. As noted in the previous section, the adoption of PBU charging is founded on the Polluter Pays Principle, which has been defined as 'the principle that those causing pollution should meet the costs to which it gives rise' (EEC, 1975). The primary aim of PBU pricing is to encourage households to reduce their production of waste by charging users according to the amount they put out for collection (Nestor and Podolsky, 1998), with the result that the 'household is rewarded financially for waste reduction' (Linderhof *et al.*, 2001, p. 359). The hope is that householders will reduce the amount of waste they set out for collection either by recycling or reducing waste at source. However, globally, in practice, most waste collection companies/municipalities do not charge households strictly according to usage: instead, they commonly use a two-tier system of pricing (Miranda *et al.*, 1996). Under two-tier pricing, residents are charged

two fees for waste-collection services. The first fee is a flat rate for using the service (frequently referred to as an 'annual service charge' in this report), e.g. €120 per year. The second fee is a PBU fee, which varies with the number of bags or bins collected from the household, e.g. €8 per bin collected. According to economic theory PBU systems that are more sophisticated in reflecting the Polluter Pays Principle may have a more positive effect on waste management behaviour.

### **2.4 International Experiences of Pay-by-use Domestic Waste Charges**

Ireland is not alone in selecting PBU charges as a method for motivating householder changes in waste management behaviour towards reductions in waste and increased recycling. Indeed, these charges have been in use in other countries for some decades. For instance, PBU charges were first introduced in the USA in the 1970s and the number of communities using these systems grew rapidly during the 1990s. By 2006, 25% of the US population (about 75 million people) and about 26% of communities in the US had implemented PBU charges – including 30% of the largest cities in the US (Skumatz, 2006).

The use of PBU charges has also grown across Europe, with one or more municipalities in Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, The Netherlands, Norway, Sweden and Switzerland all implementing user charges (Kipperberg, 2007; OVAM, 1999). Countries with high population density and high land costs, such as The Netherlands and Belgium, have had a high level of PBU uptake as a response to these pressures on the landfilling of waste. An EU-wide study into PBU charges (Reichenbach *et al.*, 2004) considered Germany, Sweden, Austria, Finland, and The Netherlands as 'mature states' with regard to the use of these charges. In 1999 a study in The Netherlands found that 22% of municipalities in the country (13% of all households) had a PBU charge (Eunomia, 2003). By the end of the 1990s 70% of the Norwegian population and 200 of the 435 Norwegian municipalities had a user-based fee (Kipperberg, 2007).

Outside the US and Europe several other countries have also implemented these charges: in New Zealand, as many as 25% of communities employed volume-



based charges for MSW collection by 1997 (Stavins, 2001); by 2000 several cities in Taiwan, including Taipei city, adopted a pay-per-bag charge (Yang and Innes, 2007; Chang *et al.*, 2007) and by 1995 South Korea had introduced PBU to all municipalities nationwide (Hong, 1999).

Such widespread international experience of PBU domestic waste charges has established that these charges result in reduced waste to landfill/incineration. However, the extent of residual waste reduction varies widely amongst these studies with the cases recording reductions of between 6 and 56% (Bauer and Miranda, 1996; Dijkgraaf and Gradus, 2004; Dunne, 2004; Dunne, 2005; Fullerton and Kinnaman, 1996; Kinnaman and Fullerton, 2000; Linderhof *et al.*, 2001; Miranda and Aldy, 1998; Nestor and Podolsky, 1998; Skumatz, 2000; Sterner and Bartelings, 1999).

The wide range of experiences of PBU may be as a result of the use of different PBU systems. Examination of the literature reveals that regions implementing weight-based systems experienced a larger decrease in waste to landfill than regions implementing volume-based systems. These findings are consistent with the predictions of theoretical PBU models that conclude that weight-based systems are the most successful in effecting change (see, e.g. Dijkgraaf and Gradus, 2004; Fullerton and Kinnaman, 1996). However, the observation that regions implementing weight-based systems experienced a larger decrease in residual waste than regions implementing volume-based systems is based upon an assessment of the findings of individually authored papers whereby each paper examines one PBU system in one area. Actual comparative studies of several different PBU charging systems over a whole region or country (such as has been done in this study) were not identified.

## **2.5 Contribution of Ireland's Experience of Pay-by-use to International Knowledge**

Comparative studies take several areas and compare their experiences directly with one another, examining the reasons for any differences. A limited number of specific comparative studies of PBU charging systems have been conducted (Linderhof *et al.*, 2001; Miranda *et al.*, 1996). The research is generally conducted

at a municipal level and city/county authorities are contacted for information on waste systems and waste diversion figures. Miranda has conducted a number of comparative policy studies (Bauer and Miranda, 1996; Miranda and Aldy, 1998; Miranda and Bynum, 2002) at the municipal level. These studies compared the effects of different collections, containers, prices and educational programmes in specific case study communities.

Comparative policy studies face a number of difficulties in evaluating the success of one system of PBU pricing over another. The success of a pricing system will be influenced by a large number of factors, such as population demographics, historical waste management systems, whether the location is rural, suburban or urban, access to recycling facilities, illegal diversion legislation, and systems of monitoring and enforcement. On this basis, the success of a waste management system may not be as a result of the specific PBU charging system used but because of a number of other factors. In this respect a comparative study of PBU systems in Ireland is at an advantage, as Ireland has small and fairly homogenous population but uses three main PBU systems, as outlined previously. These factors make for a unique opportunity to compare different PBU systems within one setting. In addition, this research examined PBU charges from more than one perspective, taking into account the sustainability of each PBU system. A sustainable system will be functional in terms of three key areas: the environment, society and economy. This study not only examined the impact of the systems upon the environment to determine which systems most successfully prompted recycling and waste reduction, but also took into account that, in addition to a system's environmental effectiveness, an optimised system needs to be easily applicable by waste collectors and to be economically effective. With this in mind, the study examined the implications of each PBU system on the waste collector, to include all aspects involved in establishing and running the system. Likewise, any system that is to be implemented will require public support and householder acceptance to enable its success; on this basis, the research included a household level survey to determine household opinions on PBU systems. This comprehensive study of PBU domestic waste systems is distinct from existing PBU studies (which tend to

focus on only one area of impact), increasing the value of this current research to international knowledge. The research will add to scientific knowledge on the value of PBU in domestic waste management, and it will also examine areas with little previous study internationally – the relationship between PBU and source reduction, the implications of PBU from a waste-collector perspective, the experiences of householders living within various PBU systems, and a comparative study of the impacts of differing PBU charging systems. In this manner the research will add greatly to the international knowledge base on PBU in waste management.

## **2.6 Relevance of Pay-by-use Domestic Waste Charges to National, European Union and International Waste Policies and Targets**

The main focus of the research was on waste prevention, waste diversion, and the value of economic instruments for national waste policy, particularly in implementing the polluter pays principle. These research aims reflect national and international objectives. These objectives employ the higher tiers of the waste hierarchy by focusing on waste prevention and decreasing waste to landfill, and applying the Polluter Pays Principle to waste management.

### **2.6.1 Increase Waste Prevention**

A key aim of domestic waste management policy is to prevent waste (see DoEHLG, 1998; *An Action Plan for the Millennium* [Department of an Taoiseach, 1998], the *National Waste Prevention Programme, 2020 Vision* [EPA, 2007] and the *Draft Statement of Waste Policy, 2010* [DoELHG, 2010]). This is also reinforced in legislation such as the EPA Act, 1992; Waste Management Act, 1996; Waste Management (Amendment) Act, 2001; Waste Management (Packaging) Regulations, 1997; Waste Management (Packaging) (Amendment) Regulations, 1998; the Protection of the Environment Act, 2003, and so on.

Prevention is also the primary focus of EU waste policies and directives. Since 1975 the waste management hierarchy has been the basis of all official EU waste management policies. This was laid out in the two EU waste foundation directives: the Waste Framework Directive 75/442/EEC (Art. 3) and the Hazardous Waste

Directive (91/689/EEC). This policy has since been confirmed in several 'daughter' directives and proposed directives including: the EC Directive 94/62/EC on Packaging and Packaging Waste and Council Directive 1999/31/EC on the Landfill of Waste.

Prevention has also formed the cornerstone of several EU initiatives including: Fifth EC Environmental Action Programme – Towards Sustainability; European Commission Sixth Environmental Action Plan for 2001–2010 and the December 2005 Strategy on the Prevention and Recycling of Waste. This priority for prevention has been further reinforced in Article 3 of Directive 2006/12/EC on Waste.

Household waste volumes in Ireland have decreased in recent years, owing to the economic downturn, (EPA, 2008; EPA, 2009) and this research examined methods for optimising further waste reduction within a PBU framework. Economic instruments are a proven method of achieving waste reductions, and PBU is considered one of the main possibilities open to policy-makers with regard to household waste production. However, the optimisation of PBU to specific socio-economic and regional situations is a prerequisite to achieving waste reduction. Ireland has set a national target of 50% of household waste to be diverted from landfill by 2013 (*Changing Our Ways*, DoEHLG, 1998), and in 2010 a *Draft Statement Waste Policy* released for consultation proposed potential residual waste targets per person (DoEHLG, 2010). The statement recommended targets of less than 250kg per capita by 2011; less than 200kg per capita by 2014; less than 175kg per capita by 2017; and less than 150kg per capita by 2020, with fines to local authorities who do not meet these targets. However, currently there is a substantial gap between actual diversion rates and the national targets. Domestic waste collectors were required to move to PBU charges by 1 January 2005, yet in 2005 only 23% of household waste was diverted from landfill (EPA, 2006) and in 2008 the recovery rate had only reached 26% (EPA, 2007). If PBU practices are expected to deliver waste diversion targets, the initial findings suggest improvement is required in their application in order to fulfil their potential. By utilising economic instruments, PBU aims to effect change in householder waste management behaviour. In the absence of this change, PBU loses some credibility as

a waste management tool. The development of PBU is at an early stage in Ireland, working in an environment where best practice has yet to be defined let alone implemented. This research investigated methods for optimisation of PBU to ensure greater levels of waste diversion in line with national targets.

It should be noted that the continuing acceleration of the roll-out of 'brown bins'<sup>1</sup>, the implementation of the Waste Management (Food Waste) Regulations 2009 and the phased introduction of the provision of food-waste collections for households (it is proposed that all authorised waste collectors must provide such a collection service for the main cities by July of 2011, with the service being rolled out to other urban areas by January 2012) will help Ireland to achieve the targets set out in Directive 99/31/EC on the diversion of biodegradable municipal waste from landfill sites and accordingly see a significant increase in diversion levels. However, the implementation of PBU best practice can also aid these objectives significantly as well as support waste prevention and recycling.

### **2.6.2 Application of the Polluter Pays Principle to Waste Charging**

From 2002 to 2004, national policy statements on waste focused on introducing economic instruments in line with the Polluter Pays Principle to reduce the rising volume of household waste in Ireland (see DoEHLG, 2002; DoEHLG, 2004a; and DoEHLG, 2004b). This tool for reducing domestic waste was

reiterated in the EPA document *2020 Vision* (EPA, 2007) as one of the methods for reaching the goal of sustainable use of resources. These documents follow on from EU policy documents, such as the *1975 Waste Framework Directive* and the *1997 EU Strategy for Waste Management*, which espouse the use of economic instruments in waste management to reflect the Polluter Pays Principle.

In the European Commission's *Sixth Environmental Action Plan*, (EEC, 2002, pp. 3–4) under the heading 'Sustainable Use of Natural Resources and Management of Wastes' the following objective and contexts are listed:

Objective – to ensure the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment. To achieve a de-coupling of resource use from economic growth through significantly improved resource efficiency, dematerialisation of the economy, and waste prevention... A strategy is needed aimed at measures, such as taxes and incentives, to ensure a more sustainable use of resources. Waste volumes are predicted to continue rising unless remedial action is taken. Waste prevention will be a key element of an integrated product policy approach. Further measures are needed to encourage recycling and recovery of wastes.

This study aimed to investigate how these policies and strategies were being supported by the implementation of pay-by-use charging systems in Ireland.

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1 A separate, segregated waste collection infrastructure for the domestic organic waste stream

## 3 Methodology

### 3.1 Introduction

The project was broken up into four main tasks (or work packages) in order to achieve the stated objectives:

- 1 First, an international literature survey was carried out to inform the team of the latest developments in PBU charges in other countries. This is presented in a separate report.
- 2 Next, an analysis of PBU implementation in Ireland was carried out in order to identify the different types of PBU systems in place and how they are being applied. It was also necessary to estimate the impact of all possible PBU systems, and their individual components, on waste reduction, recycling and residual waste sent to landfill. This is presented in Section 4.1 of this report.
- 3 The team then assessed waste-collector implications regarding PBU implementation in order to examine the consequences of each PBU system on the waste collector, and to review the viability of each PBU system in use in Ireland as a means of waste charging from the perspective of the waste collector. This is presented in Section 4.2 of this report.
- 4 The fourth main task was to assess the impact of PBU implementation on householders in order to evaluate the impact of all possible PBU systems on the public, in terms of both waste management behaviour and ease of use and to generate an overview of household experiences of each PBU system. This is presented in Section 4.3 of this report.

### 3.2 Waste Collector Study

The study of potential optimised PBU domestic waste systems for Ireland required information from Irish waste collectors (private and public) implementing PBU charges, to determine their experiences of these systems. In order to gather these data, three methods were used: (i) a waste collector survey, (ii) discussions with waste collectors and stakeholders and

(iii) an examination of private waste collector *Annual Environmental Reports* (AERs).

The two main aims of the survey and AER analysis were to:

- Analyse the implementation of PBU in Ireland; and
- Examine the impact of PBU systems on the environment.

A third aim of the waste collector survey was to assess waste collectors' views and experiences with respect to their own (and others') systems.

With this information, a picture of PBU implementation in Ireland was developed, outlining which systems are most and least common, trends in their usage, the range of charges issued to householders within each system, the availability of kerbside recycling services, the frequency of bin collections, and so on.

In addition, the figures provided allowed for an analysis of the impact of PBU systems on rates of waste disposal, recycling and on total waste levels (considering, for example, possible reductions in waste because of charging systems). Furthermore, the findings from the survey indicated waste collectors' opinions and experiences of PBU systems, revealing what they consider to be the advantages and disadvantages of each system, whether or not they would recommend the system they use, and any changes they are considering regarding charges.

Data were gathered from all the 15 local authorities that collected domestic waste in 2009, using a survey and follow-up interviews (a 100% response rate). From the 80 private companies that may be collecting domestic waste, 12 completed responses were received (a response rate of 15%). Adding in findings (mainly qualitative, not quantitative) from the 6 collectors interviewed in the O'Callaghan-Platt and Davies study (2008) resulted in information on PBU from 18 of the 80 private collectors operating in Ireland (22%). To increase the private collector representation, the research team gathered the 2008 AERs for other private

domestic waste collectors. These were provided by 18 local authorities, resulting in 79 AERs, representing both urban and rural communities, and companies of different sizes from all over Ireland. Thus, in total, 97 data sets were gathered for private waste collectors.

However, of the 97 private waste collector data sets, some were discounted from the analysis because:

- Some did not provide details on the PBU system used (and had no name provided, thus preventing follow-up queries);
- Some companies use more than one PBU system and their waste-collection figures are not separated according to the systems used;
- Each survey response/AER was assessed to determine the validity of the figures on a per household level. Some data sets were removed from the analysis following this assessment. For example, the calculation from one data set led to a per household annual recycling level of 2kg – this is clearly erroneous. In this case, the recycling figure may be low owing to an incorrect assumption that all households with a residual waste collection by the operator also had access to and used a recycling collection. The total number of households served by a collector is provided in the AERs but information on how many of these households also have a recycling service is not always provided. For reasons such as this some data sets could not be included in the analysis.

When assessing the validity of data it was noticed that per household figures provided by some tag-a-bag collectors varied widely from per household figures provided by collectors using other PBU systems. These tag-a-bag collectors do not use an annual service charge and thus they do not have an accurate knowledge of the number of households served weekly by their collection service; any household in their collection area may buy one of the collector's waste bags in a local shop and present it for collection. Without accurate household numbers, many of the figures for residual and recycling waste were abnormal at a household level. For example, calculations with the data provided by tag-a-bag collectors led to figures such as 2kg of recycling/household/year and 3,300kg of residual waste per household per year. Figures

such as these were clearly inaccurate and on this basis figures for tag-a-bag collectors were removed from the final analysis,<sup>2</sup> and are not included in the findings presented for tag-based systems in any of the following sections.

Following these deductions, usable data were available for 48 private collector data sets from all over Ireland, servicing 298,848 households.

As noted above, all 15 local authorities that collect domestic waste provided data for the study. However, one of these local authorities has three separate waste-collection areas which gather data separately, resulting in a total of 17 local authority data sets. Of these 17 local authority data sets:

- One uses a tag-a-bag system and was omitted from the analysis (since again the number of households served is impossible to know);
- Data from one tag-a-bin collector were omitted as, when analysed by the research team and queried, the data provider agreed that it was erroneous;
- One collector uses more than one PBU system and was omitted from the analysis as separate figures for each system were not available.

Following these deductions usable data were available for 14 local authority data sets, servicing 494,003 householders.

When local authority and private waste collector data were combined it resulted in 62 data sets accounting for 792,851 households (over 50% of all households in Ireland)<sup>3</sup> for analysis.

Of these 62 data sets:

- 26 (42%) use a differential bin size system;
- 14 (23%) use a tag-based system;
- 22 (35%) use a weight-based system.

The three forms of PBU used by domestic waste

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2 Only one tag-a-bag collector had residual and recyclable figures that were considered to be possibly accurate, but since this was such a small sample it was not compared to other systems.

3 Ireland (Republic of Ireland) had 1,469,521 households in 2008 (<http://www.cso.ie/statistics/numprivhseholds.htm>).

collectors in Ireland (tag-based systems, weight-based systems and differential bin size charges) were examined to determine their implementation impacts on householders, the environment, and waste collectors.

### **3.3 Household Study**

The objective of the household study was to evaluate the impact of all PBU systems on householders. Information about their waste management issues was received from 790 households in a large-scale survey.<sup>4</sup> The survey gathered data on:

- The waste-collection system used by surveyed householders;
- The impact of PBU charges on their waste disposal behaviour;
- Their views on PBU charges.

PBU systems were examined in terms of both waste management behaviour and ease of use, to generate an overview of household experiences of each PBU system. Studies into determinants of the success of PBU have found that public acceptance is key to the effective functioning of a PBU system (Cantebury, 1998). On this basis, determining householder experiences and opinions of PBU systems may result in the development of an improved system, with corresponding improvements in waste diversion and prevention.

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<sup>4</sup> Two surveys were conducted to gather householders' opinions on PBU domestic waste charges. Survey 1 used a small non-representative sample. The households that responded to Survey 1 had a higher than average level of education. In addition, since many of the Survey 1 responses were gathered via a local pilot study, these respondents were located in one area and as a result had the same PBU system and collector. Survey 2 was carried out by a professional survey company over the phone using a sample group of 1,000 households that are well representative of Irish society. Of the 1,000 households contacted, 790 people answered that they were the responsible person for waste management in the home, and thus this number was surveyed. On this basis, the results presented within this report are those from the analysis of Survey 2.

### **3.4 Potential Sources of Error and Notes on the Results**

As with all data-gathering exercises there are potential sources of error and this study is no exception. Two main types of data were gathered during the study: qualitative and quantitative. For the quantitative data, the research team depended on sources such as the EPA *National Database Surveys*, data received directly from collectors (mainly local authorities) data from AERs, and data from householders. Regarding the qualitative data (opinions, beliefs, likes, dislikes, statements of intent, etc.), these were considered to be accurate and reflecting the sources' real views except where known errors occurred in items of fact.

However, as is often the case with such a large-scale study, there are possible areas of inaccuracy, anomalies and gaps in the data. These can be described as follows:

- All data were self-reported by the waste collectors, either via survey response or in the AERs. Local authority survey responses were followed up by a meeting with the collector to discuss their experiences of PBU further and to query any anomalies. Meetings were also carried out with private collectors but this related more to qualitative than quantitative information.
- Although all local authority domestic waste collectors were surveyed for the study, data were not available from all private domestic waste collectors in the country: 18 of the 34 local authorities (53%) provided AERs from private collectors for the study. Owing to this, it should be kept in mind that the results do not include data from every domestic waste collector in the country nor every household.
- Several collectors are in the process of rolling out an organic waste-collection service to domestic customers. For the majority of collectors this service was in the early stages of delivery and only available to a small percentage of their customers. This waste stream was not included in the analysis, as to do so would distort the figures. However, where an organic collection was available to all or most of the customers, the analysis is presented both with and without these figures.



- Where figures for subsections of a PBU system are reported it should be noted that each subsection may be comprised of a limited number of collectors. For example, only four of the collectors examined, providing seven data sets, use a 'per kilogramme' form of weight-based charge. On this basis caution is advised when viewing these figures.
- Figures were calculated for each waste collector by dividing the tonnage of each waste stream collected (residual waste, recycling waste and organic waste) by the number of households with this collection service. This resulted in per household weights of waste, which are then comparable to other systems. The percentages of total kerbside waste to residual waste bins, recyclables bins and organic waste bins were then calculated. All collectors were placed in groups based on the PBU system used for the purposes of PBU system comparison.
- This study examined only domestic waste presented at the kerbside (i.e. waste placed in householders' residual waste, recycling and organic wheellie bins or bags for collection). Although local authority collectors provided figures for civic amenity sites (CAS) and BB within their functional area, it was not possible to use these data effectively with regard to the analysis of PBU systems. It was not possible to integrate these figures into the analysis (and get per household figures) since CAS and BB are used by all households and many businesses in the region, regardless of the PBU system they use, whether their waste is collected by a private company or local authority, or whether it is sourced locally or not. However, it should be kept in mind that, in addition to the waste that householders present at the kerbside, many households also use BB and CAS to recycle, especially with regard to glass, bulky items, garden waste, and so on. Since the calculated recycling rates listed in this report are based solely on waste at the kerbside and do not take recycling at CAS and BB into consideration, it can be assumed that overall household actual rates of recycling are higher than those outlined in this report.
- In the household study, the subjectivity of values poses a difficulty when assessing responses. For example, households were asked to rank the impact their PBU charge has had upon their waste management behaviour on a scale of impact level between 1 and 10, with 1 equal to 'no impact at all' and 10 equal to 'very high level of impact'. Individual interpretation of what each number on the scale represents determines where each respondent ranks their PBU charge. In addition, the analysis required the numbers within the ranking system to be grouped into categories of 'high impact', 'some impact' and 'low impact': this again is subjective and the grouping affects the findings of the research.
- Analysis of the survey responses revealed a certain lack of understanding of waste charges among households. Despite a finding in Survey 1 in which 70% of respondents stated that they understood their waste charge, 12% of respondents did not know how their waste charges were calculated. In addition, several respondents may have incorrectly identified their PBU system: 86 respondents stated that they used a local authority waste-collection service, and that their PBU system is a differential bin size charge. As only two local authorities in Ireland offer differential bin size charging this appears an exceptionally high number of respondents and could imply that some householders did not really know which system they used. Asking households if their waste charge is based on weight or based on the number of tags/lifts may be clearly understood, but asking about the use of a differential bin size system proved more difficult. There is no commonly used term for this PBU system and the research team selected to ask respondents if their charge is calculated 'using an annual charge based on bin size' in place of the term 'differential bin size'. The possible misinterpretation of this phrase highlights a lack of appropriate language to allow households to understand PBU. Where households may have incorrectly identified their PBU system, it could have led to their responses being incorrectly grouped for analysis. For example, if a household reports that they use a differential bin size service but actually use a tag-based service they will be placed within the differential bin size group, and analysed as part of that group.
- Owing to the sensitive nature of the topic, questions focused on illegal waste diversion may not have been answered honestly.

## **4 Impacts of Pay-by-use Systems in Ireland**

The following sections outline the results of the impacts of each PBU system on the environment, on waste collectors and on householders.

Section 4.1 provides the results of the environmental impacts of each PBU system. Here, the systems are compared to find out which achieves the highest recycling and the lowest total kerbside waste levels, leading to conclusions on which systems are the most effective and which are the least effective from an environmental perspective.

Section 4.2 outlines the findings of the impact that each PBU system has upon waste collectors. This section also covers other topics raised by waste collectors in the course of discussions on PBU.

Section 4.3 reports on the responses to the survey of householder opinions on PBU domestic waste systems. This section covers the issues of opinions on whether links exist between PBU and recycling, waste reduction, inconveniences and illegal waste disposal, among other issues.

### **4.1 Impact of Pay-by-use Charges on the Environment**

Quantitative data from 62 domestic waste-collection systems, servicing 792,851 households, were used for calculations into the impacts of PBU systems on the environment. The main aim of this area of research was to identify which PBU charging systems could prompt waste reduction, by comparing the average total kerbside waste presented per household within each system. The second aim was to determine which system resulted in the largest diversion of waste away from landfill, through recycling, and so on.

The research found that in Ireland weight-based PBU charges are more effective than tag-based and differential bin size charges in reducing the negative impacts of domestic waste. These charges have prompted householders to present less waste in total and to divert more waste from their residual waste bin than tag-based or differential bin size charges. Households using a weight-based charging system

have a higher rate of recycling, and lower average total waste levels, as presented at the kerbside, than either tag-based or differential bin size charges.

However, there are three forms of weight-based charge and differences were found between the experiences of each type.<sup>5</sup> The three forms are 'per kilogramme', 'average weight' and 'banded weight'. The 'per kilogramme' system involves the use of a charge per kilogramme (kg) of MSW placed out for collection in wheelie bins, in addition to an annual flat rate service charge. When the bin is lifted, its weight is recorded and the householder is later issued with a bill which includes a portion of the service charge and the charge for the weight of waste presented by the householders. The 'banded' weight-based system uses several weight brackets that an annual bin weight may fall within, with a different price for each weight bracket. The 'average weight' weight-based system uses a calculated average household waste presentation rate (commonly 800kg per year), if a household produces less weight than this average they receive a reduction on their next annual bill and if a household produces more weight than this average they are billed for the additional weight.

The 'per kilogramme' form of weight-based charging is the most effective system in terms of kerbside recycling and total waste figures, with 'banded weight' and 'average weight' systems experiencing less success, with the 'average weight' system prompting figures similar to tag-based and differential bin size charges when the three weight-based systems are considered separately.

The differential bin size charging system charges households a flat fee based on the residual bin size they select to use, so the annual charge for a 240-litre residual bin will be more expensive than the charge for

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5 Note: there are not many collection systems within each individual form of weight-based charge, therefore, caution is required when reading these particular sub-findings. Nine systems use an 'average weight' system, six use a 'per kilogramme' system, three use a 'banded weight' system and for four weight-based collectors the form of weight charge used was unknown.



a 140-litre residual bin. Once the annual charge is paid, the householder can present their bin as often as they like, with as much waste as they like, without incurring any additional cost.

The environmental outcomes of tag-based systems varied widely, with collectors reporting environmental outcomes both similar to those for weight-based charges and those for differential bin size charges. At their best, tag-based charges can be considered successful from an environmental perspective.

In addition to analysing all collectors together within their PBU system groupings, local authority data and private collector data were also considered separately. This also found that weight-based systems are the most effective PBU systems environmentally, followed by tag-based systems, with differential bin size charging the least environmentally effective of the three.

These findings were corroborated by an analysis of the literature and of the economic theory behind PBU charges.

#### 4.1.1 International Literature

It is clear from the international literature and this study of PBU charges in Ireland that differential bin size systems are the least effective PBU system in reducing residual waste and reducing total kerbside waste. This can be attributed to the lack of incentive provided to householders to reduce the amount of waste they place out for collection below the minimum bin size available to them. For example, if a household selects to use a 140-litre bin under a differential bin size system, the householder will not reduce their waste costs if they do not fill the bin: therefore, they have no incentive to change their waste management behaviour to divert waste from landfill any further than is necessary to prevent exceeding the limits of the bin. In this manner, differential bin size systems do not provide a continuous pricing signal to householders, unlike both tag- and weight-based charges. Nonetheless, Miranda and Aldy (1998) found that differential bin size systems can be highly effective, but only when the bin size is small enough to 'reflect a continuous price signal for waste disposal' (Miranda and Aldy, 1998, p. 83). This viewpoint was also held by a collector in Ireland. This collector experiences high recycling levels and low total kerbside waste volume, both well below the average for this system, by offering households an 80-litre

residual waste bin at a noticeably lower annual fee to its larger bin sizes. Differential bin size services with a large minimum bin size do not require households to alter their waste management behaviour and increase recycling or source reduction, but there are indications that using a smaller residual bin may result in more positive environmental findings.

With regard to the remaining PBU systems, the success of weight-based charges, and in particular the 'per kilogramme' form, over tag-based charges is because weight-based charges reflect the marginal cost of waste more accurately than tag-based charges more accurately, as increases are per kilogramme rather than per bag or bin (Miranda *et al.*, 1996). In addition, both tag- and weight-based systems encourage lower residual waste levels and lower total kerbside waste levels as they allow householders to change their level of demand for waste services instantly, unlike differential bin size charges where householders commit to a bin size for a year at a time (Nestor and Podolsky, 1998).

Waste compaction, also known as 'Seattle Stomp',<sup>6</sup> may also be responsible for the greater environmental success of weight-based charges over tag-based charges. Households will want to reduce the amount of times they place their residual waste bin out for collection in order to save money, but they may reduce this frequency by compacting the waste within the bin before selecting to divert or prevent waste.

#### 4.1.2 Waste Prevention

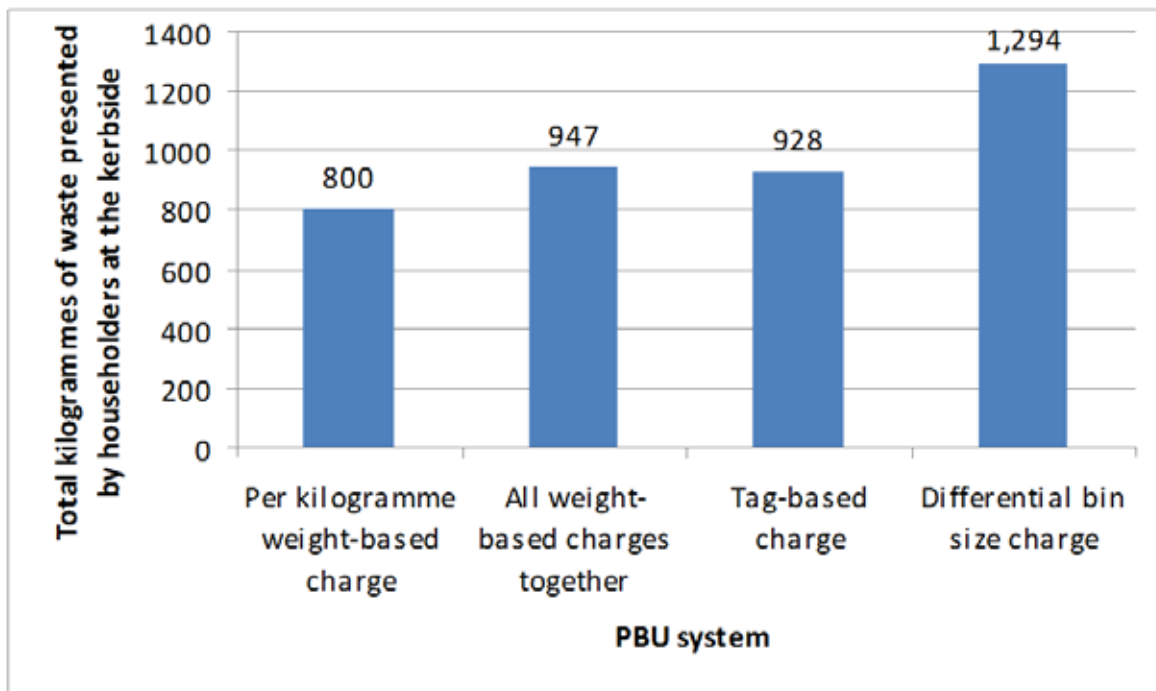
The average weight-based household presents less waste at the kerbside in total than the average household using tag-based or differential bin size charges. The analysis found substantial differences in the amount of total waste presented under the three main systems:

- The average total waste presented by householders under all systems in the 62 data sets is 995kg per household in 2008. The minimum total kerbside waste for any system is 595kg and the maximum is 2,246kg per household.

6 When volume based charges were first introduced in Seattle, some householders compacted their waste (sometimes by 'stomping' on it) in order to reduce their charges (per collection). Some went so far as to buy and use compactors for this purpose leading to difficulties for the collectors, both economic and in relation to the collection of very heavy bins.

- The average total kerbside waste for the 14 tag-based collection systems (covering 447,212 households) that provided 2008 data is 928kg with a range from 596kg to 1,890kg per household.
- The 22 weight-based collection systems (covering 210,690 households) have an average total waste per household of 947kg, and the range in the per kg-based households is from 646kg to 1,479kg per household.
  - Average total kerbside waste (including both recycled and residual waste) under a 'per kilogramme' system is 800kg<sup>7</sup> per household;
  - Average total kerbside waste under a 'banded weight' system is 950kg<sup>8</sup> per household;
  - Average total kerbside waste under an 'average weight' system is 1,206kg<sup>9</sup> per household.
- Under the 26 differential bin charging systems (covering 134,949 households) the range varied from 777kg to 1,821kg, with an average of 1,294kg per household.
- These data are summarised in [Fig. 4.1.1](#), which shows that households with tag-based systems presented the lowest average total waste at the kerbside (928kg), followed by weight-based systems (947kg), with differential bin size households presenting the greatest amount of average total waste for collection (1294kg), much greater than the other two.

However, for the weight-based charging systems, there are large differences between total waste figures per household presented under each form of weight-based charge used, with 'per kilogramme' charges presenting less total kerbside waste (800kg) than 'banded weight' (950kg) and 'average weight' charges (1,206kg).



**Figure 4.1.1. Average kilograms of waste per household presented at kerbside for different pay-by-use (PBU) systems.**

<sup>7</sup> Note that this figure was calculated from six data sets.

<sup>8</sup> Note that this figure was calculated from three data sets.

<sup>9</sup> Note that this figure was calculated from nine data sets.

#### 4.1.2.1 Statistical analysis

While the average or mean per annum total waste from tag-based systems (928kg) may appear lower than that of weight-based systems (947kg) in [Fig. 4.1.1](#), in many instances, where sample sizes are low (usually < 30), such figures can be misleading. In such cases a statistical t-test may be applied to determine if the two means are actually different.

At the 95% confidence level (the level usually chosen by statisticians), if the calculated p-value from the t-test is less than 0.05, then there is a true difference between the means. For example, in [Table 4.1.1](#) the sample mean values of 947kg and 928kg appear to be different. However, the parameters for the t-test, and the resulting outputs, are 0.4666. Since p is *not* <0.05, there is no statistical difference between the means. This indicates that, with regard to the total amounts of weight arising from these two systems, there is no actual difference in the results.

When the t-test is carried out between the per-weight system (800kg) and the tag-based system (928kg), the p-value is 0.0027, well below 0.05 so there is a difference between these. Likewise, when the tag-based system (928kg) is compared to the differential sized bin per household mean (1294kg), the p-value is 0.003 – again indicating a real difference in values (see [Table 4.1.1](#)).

Thus, it can be said that the 'pure' per weight PBU systems is the most environmentally friendly system with regard to overall waste amounts presented per household; the average pay-by-weight and tag-based systems are indistinguishable; and the differential bin system is the least environmentally friendly in this regard.

#### 4.1.2.2 International literature

The international PBU literature was examined to see how the Irish experience relates to that found worldwide. Unfortunately, there is relatively little literature on this topic and of the studies that do exist there is little consensus, with several studies finding that source reduction does occur under PBU charges, and others finding no evidence of source reduction. Adamec (1991), Dijgraaf and Gradus (2004), ERRA (1998), Eunomia (2003), Hong (1999), Miranda and Aldy (1998), Miranda *et al.* (1996), Öko-Institut (1999), Skumatz (2000), Sterner and Bartelings (1999), Stone and Harrison (1991), Tønning (2000) and Yang and Innes (2007) all reported decreases in total waste levels at the kerbside under PBU charges. Efav and Lanen (1979), Eunomia (2003), Hong (1999), Savas *et al.* (1977), Sebastien (2005) and Stevens (1977) all found that PBU charges did not prompt waste-prevention behaviour.

Where figures are recorded, they are largely reported in terms of a percentage reduction in total waste on the introduction of a PBU charge and so in this respect are not directly comparable to the figures in the current research. In addition, even if the weight of total waste presented per household were provided in all of the literature, these figures would not be directly comparable to this study's findings as many factors such as worldwide geographical location would have a large influence on total waste levels. Despite these problems, the literature allows an examination of the patterns of total waste levels arising based on PBU systems, and a comparison of these patterns to those found in Ireland.

**Table 4.1.1. t-values for average weights of different systems.**

Sample	Sample size N	Sample mean	Sample standard deviation	t-value of difference	p-value
Weight-based	22	947.23	36.07	0.771	0.4666
Tag-based	14	927.53	91.18		
Per kilogramme weight Based	6	799.89	63.08	3.6	0.0027
Tag-based	14	927.53	91.18		
Differential bin-based	26	1294.09	87.53	-12.218	0.003
Tag-based	14	927.53	91.18		

In terms of the varying impacts of the different PBU systems, the literature review found that:

- Weight-based charges are the most likely to prompt waste-prevention behaviour;
- Differential bin size charges are the least likely to encourage waste prevention; and
- The literature disagrees on the impact of tag-based charges, with some studies finding results comparable to weight-based charges and others finding results comparable to differential bin size charges.

This pattern is also found in Ireland, with weight-based charges resulting in the greatest waste prevention, and differential bin size charges leading to the lowest waste prevention. In this respect, the Irish experience reflects the international experiences of PBU waste charges.

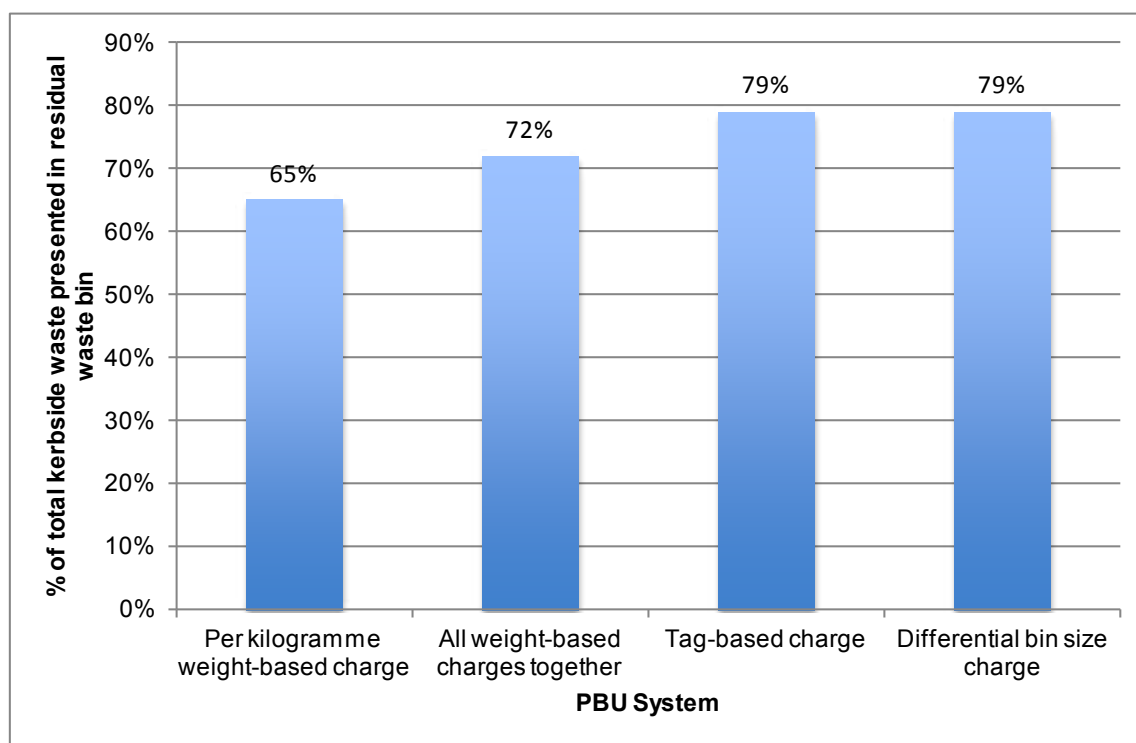
Moreover, the literature reported that waste prevention is also influenced by the presence of other waste management services, such as kerbside recycling services and organic waste collection services. The

availability of kerbside recycling does not necessarily encourage waste prevention behaviour as householders can reduce the amount of waste placed in their residual waste bin by diverting waste to recycling without any need to engage in any source-reduction behaviours, such as changing purchasing habits.

As all waste collection services studied in Ireland had a kerbside recyclables collection, this issue was not examined in the reported research.

#### **4.1.3 Diversion of Waste from Landfill – Residual Waste**

On average, householders in weight-based areas placed 72% of their total kerbside waste into the residual waste bin. In comparison, the tag-based householders placed, on average, 79% of waste in their residual waste bin, and the differential bin size householders also placed 79% of their total waste in this bin. In the purely 'per kilogramme' weight-based areas, 65% of total kerbside waste, on average, was placed in the residual waste bin.<sup>10</sup> Figure 4.1.2 summarises the findings.



**Figure 4.1.2. Percentages of total kerbside waste presented in residual waste bin for different pay-by-use (PBU) systems.**

<sup>10</sup> This analysis entailed removing the data from two of the weight-based collectors and one of the tag-based collectors since they also collected organic waste separately. This meant a relatively low level of residual waste in those areas, which would have led to not comparing like with like, had they been included.

The following pages detail the figures found for residual waste within each PBU system.

#### 4.1.3.1 PBU system: Weight-based

The percentage of total waste presented in residual waste bins by households within a weight-based system ranged widely – from 57% to 86%. On average, householders using weight-based collectors placed 72% of their total presented waste into the residual waste bin.

As three forms of weight-based charge are used by collectors in Ireland, the figures for each data set were

studied further. [Table 4.1.2](#) outlines the per household figures calculated for each weight-based data set.

'Per kilogramme' charges are the most effective weight-based charge for diverting waste from residual waste bins, with an average of 65% of total kerbside placed in the residual bin. Households with 'banded weight' systems placed on average 74%<sup>14</sup> and 'average weight' households placed 79% of their waste in the residual bin. Under a 'per kilogramme' charge the percentage of total waste presented in residual waste bins ranged from 47% to 79%, the range varied from 66% to 81% under 'banded weight' and 69% to 86% under an

**Table 4.1.2. Per household waste collection figures for weight-based charging systems**

Weight-based system	Percentage to landfill	Percentage recycling	Total kerbside waste (kg)
'Average weight' data set 1	86	14	926
'Average weight' data set 2	86	14	860
'Average weight' data set 3	85	15	1041
'Average weight' data set 4	85	15	1039
'Average weight' data set 5	83	17	757
'Average weight' data set 6	78	22	1479
'Average weight' data set 7	75	25	1116
'Average weight' data set 8	70	15 <sup>11</sup>	864
'Average weight' data set 9	69	31	1315
'Banded weight' data set 1	81	19	1060
'Banded weight' data set 2	70	30	859
'Banded weight' data set 3	66	34	850
'Per kilogramme' data set 1	79	21	1356
'Per kilogramme' data set 2	60	40	657
'Per kilogramme' data set 3	57	43	646
'Per kilogramme' data set 4	69	31	712
'Per kilogramme' data set 5	47	23 <sup>12</sup>	1002
'Per kilogramme' data set 6	74.5	25.5	832
Unknown PBW data set <sup>13</sup> 1	76.5	23	1076
Unknown PBW data set 2	79	21	1034
Unknown PBW data set 3	72	28	958
Unknown PBW data set 4	73	27	939

11 This collector provides a separate organic waste collection; the remaining 30% is placed in this stream. These data were removed from the analysis of averages.

12 The form of weight-based charge used by these four collectors is not known.

13 Two of the three 'banded weight' data sets are from one collector. This collector's success may not be based on its PBU system but other factors and its diversion figures will impact upon the average figure for 'banded weight' systems.

14 Note that the residual waste and dry recycling rates do not add up to 100% due to the fraction of organic waste also collected separately in tag and weight-based areas.

'average weight' charges. However, as can be seen from [Table 4.1.2](#), some of these data sets are quite small within this category.

#### *4.1.3.2 PBU system: Tag-based*

The percentage of total kerbside waste placed in the residual bin under tag-based systems ranged from 75% to 93%. On average, tag-based householders placed 79% of waste in their residual waste bin.

#### *4.1.3.3 PBU system: Differential bin size*

The percentage of total waste presented in residual waste bins by households within a differential bin size system varied from 67% to 90%. On average, householders using differential bin size-based collectors placed 79% of their total presented waste into the residual waste bin.

#### *4.1.3.4 International literature*

The majority of international studies conclude that PBU charges successfully decrease the amount of waste collected in residual waste bins in both the long and short term (Dijkgraaf and Gradus, 2004; Linderhof *et al.*, 2001; Sterner and Bartelings, 1999). However, the extent of residual waste reduction varies widely amongst these studies with the cases recording reductions of between 6% and 56% (Bauer and Miranda, 1996; Dijkgraaf and Gradus, 2004; Dunne, 2004; Eunomia, 2003; Fullerton and Kinnaman, 1996; Hogg, 2002; Hong, 1999; Kinnaman and Fullerton, 2000; Linderhof *et al.*, 2001; Miranda and Aldy, 1998; Nestor and Podolsky, 1998; Seguin *et al.*, 1995; Skumatz, 2000; Sterner and Bartelings, 1999; Yang and Innes, 2007).

The review of the international literature indicated that differential bin size systems are the least effective PBU system in reducing residual waste. Both tag-based and weight-based systems have had much greater success internationally in reducing residual waste than differential bin size systems. The figures for tag-based and weight-based systems were comparable. However, weight-based systems have been found to have a greater minimum reduction in residual waste than tag-based systems. Again the figures are reported in terms of percentage decreases in residual waste following the introduction of PBU charges rather than residual waste as a percentage of total kerbside waste and therefore not directly comparable.

As noted above, this study found that in Ireland the average percentage of total kerbside waste going to

the residual waste bin was greater under differential bin size systems than under tag or weight-based systems. This result reflects those found internationally. In Ireland it was found that weight-based charges are marginally more successful than tag-based charges in reducing the amount of waste placed in the residual waste bin. This finding also reflects those found internationally.

#### **4.1.4 Diversion of Waste from Landfill – Recycling**

The percentage of waste diverted to kerbside recycling by all collectors regardless of PBU system was calculated using the latest figures for the 62 collectors for which data were available. The analysis found that, on average, householders placed 22.5% of their total kerbside waste into the recyclables bin. The *National Waste Report* (EPA, 2008) noted a nationwide domestic recovery rate of 26% in 2008. However, this figure includes recyclables taken to CAS and BB by households.

The data showed that households using a weight-based charging system had a higher rate of recycling than households in either tag-based charging systems or differential bin size systems, with an average of 27% of total waste, to an average of 20% for tag-based collectors and 21% on average for differential bin size collectors. When only 'per kilogramme' weight-based charges are considered within the weight-based grouping, the recycling rate is higher at 32%, as [Fig. 4.1.3](#) shows.

The following page details the ranges of figures found for diversion to recycling within each PBU system.

##### *4.1.4.1 PBU system: Weight-based*

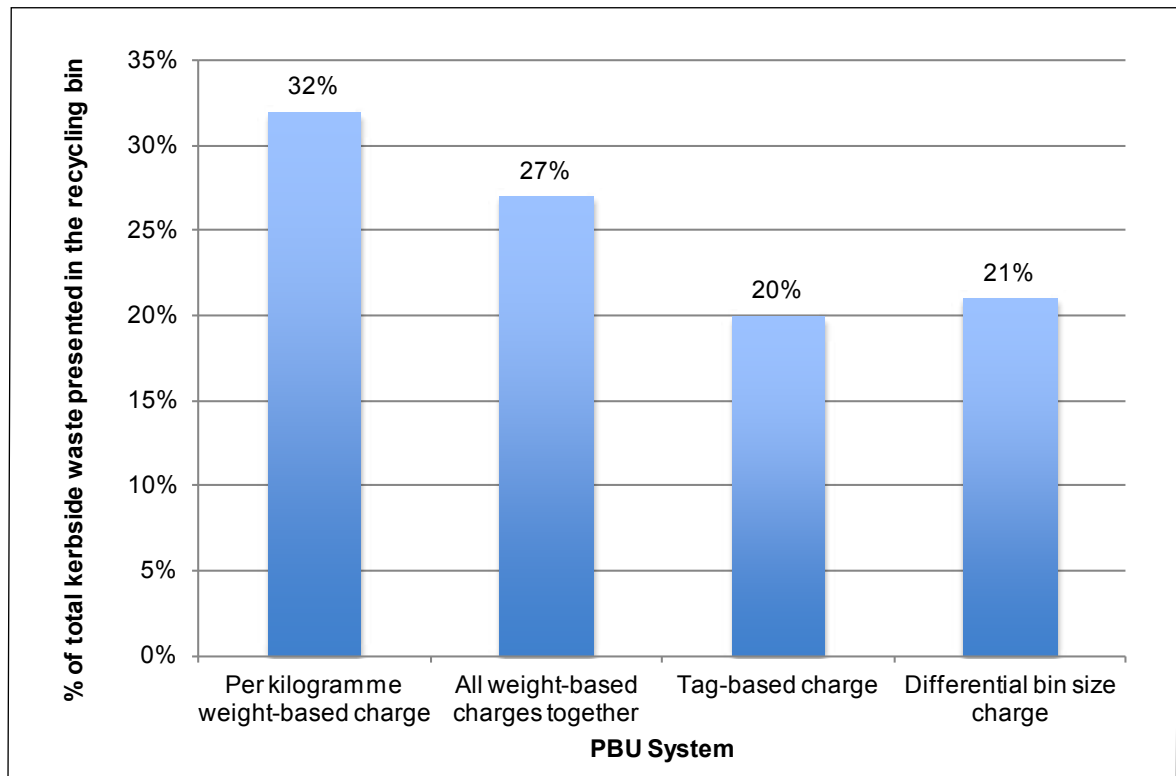
Recycling rates ranged from 14% to 43% for the 22 weight-based systems analysed, resulting in an average recycling rate of 27%.

Of the three weight-based systems used, most waste was diverted to kerbside recycling under the 'per kilogramme' system (32%), followed by the 'banded weight' system (25%), with the 'average weight' system experiencing the lowest rate of kerbside recycling (20%).

##### *4.1.4.2 PBU system: Tag-based*

The 14 tag-based collectors studied experienced DRF recovery rates of 7% to 38%, resulting in a 20% average recycling rate for tag-based systems (excluding tag-a-bag) in Ireland.





**Figure 4.1.3. Percentage of total kerbside waste presented in recyclables bin for different pay-by-use (PBU) systems.**

#### 4.1.4.3 PBU system: Differential bin size

The percentage of waste diverted to kerbside recycling for each collector using a differential bin size charging system as their only or main PBU system rates ranged from 10% to 33%, resulting in an average recycling rate of 21% for differential bin size based collectors.

#### 4.1.4.4 Distribution plot analysis

Given the ranges of results for each system and the ranges of numbers of collectors surveyed, it was considered important to prepare distribution plots for each system with regard to its recycling levels (see [Figs 4.1.4 – 4.1.8](#)). These plot the number of collectors against the percentage recycling rate. The y-axis gives the number of collectors, and the x-axis shows the recycling rates attributable to these collector fractions. If many of the data are found within a few standard deviations, with a central tendency, then the distribution is considered to have a lower variability than if there are fewer data within these bounds. This indicates that the data are more consistent; the results are of

good statistical quality and can, therefore, be better trusted. Another measure of the central tendency (tight distribution) is the coefficient of variation (CV), which is the ratio of the standard deviation to the mean. A smaller value means a higher central tendency, which, again, adds more credibility to the data.

For example,

For weight-based systems the mean is 27.15 and the standard deviation is 8.29. Thus,  $CV = 8.29/27.15 = 0.30$  ([Fig. 4.1.4](#)).

For pure per kilogramme systems the mean is 32.34 and the standard deviation is 9.14. Thus,  $CV = 9.14/32.34 = 0.28$  ([Fig. 4.1.5](#)).

For tag-based systems the mean is 19.65 and the standard deviation is 7.53. Thus,  $CV = 7.53/19.65 = 0.38$  ([Fig. 4.1.6](#)).

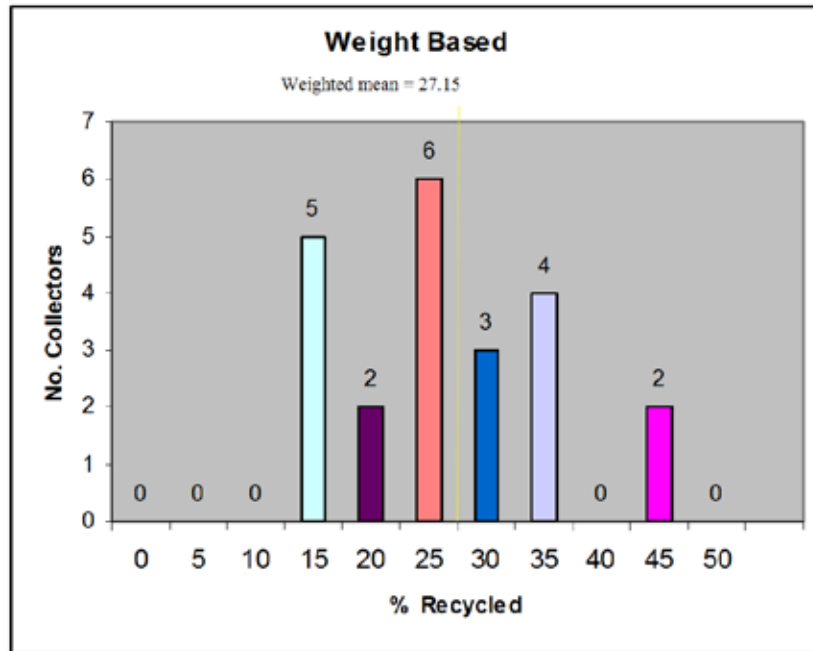
For differential bin-based systems the mean is 20.61 and the standard deviation is 10.23. Thus,  $CV = 10.23/20.61 = 0.496$  ([Fig. 4.1.7](#)).

Thus, the weight-based system data (in particular the per kilogramme data) are more centrally distributed than those of the tag-based data. This means that the former have less variation. The differential bin system has the most variation (see [Table 4.1.3](#)).

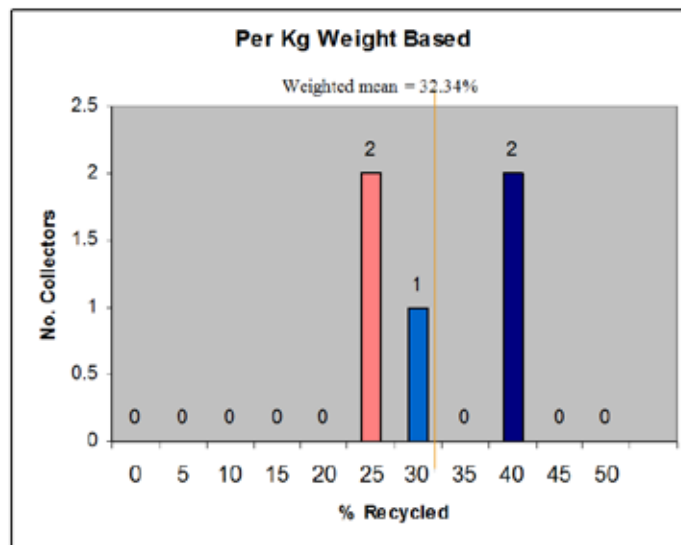
It should be recognised, of course, that the sample numbers are low.

**Table 4.1.3. Coefficients of variations for pay-by-use systems data.**

System	Coefficient of variation
Weight-based	0.30
Per kg	0.28
Tag-based	0.38
Differential bin size	0.50



**Figure 4.1.4. Weight-based systems recycling data distribution.**



**Figure 4.1.5. Per kilogramme pay-by-weight-based systems recycling data distribution.**



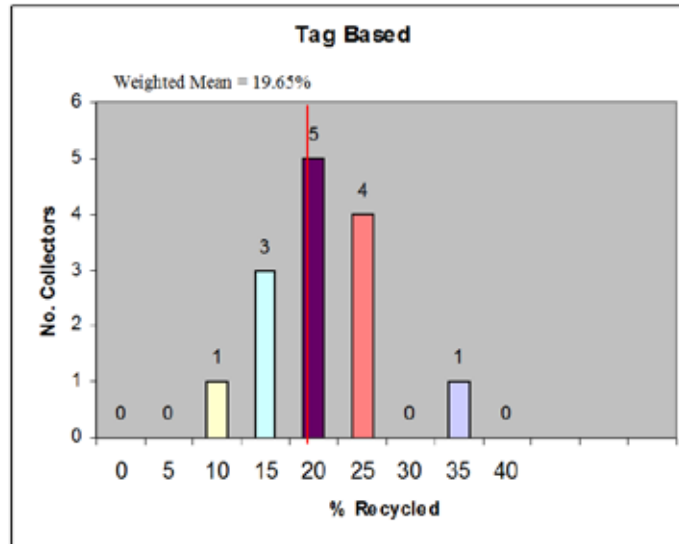


Figure 4.1.6. Tag-based systems recycling data distribution.

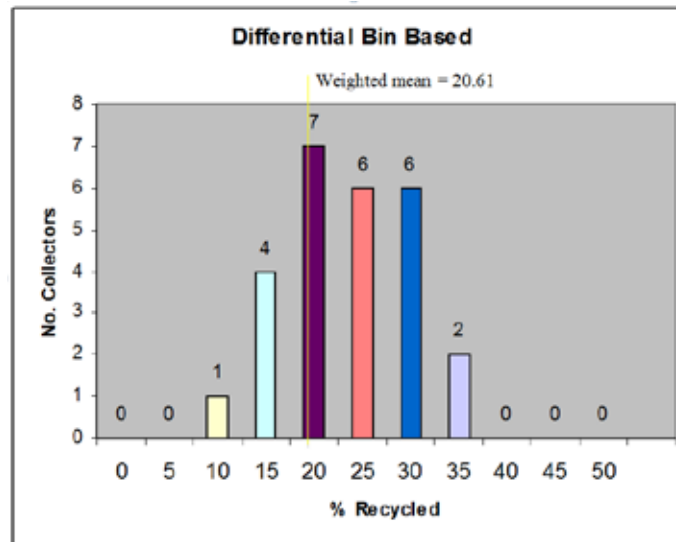


Figure 4.1.7. Differential bin-based systems recycling data distribution.

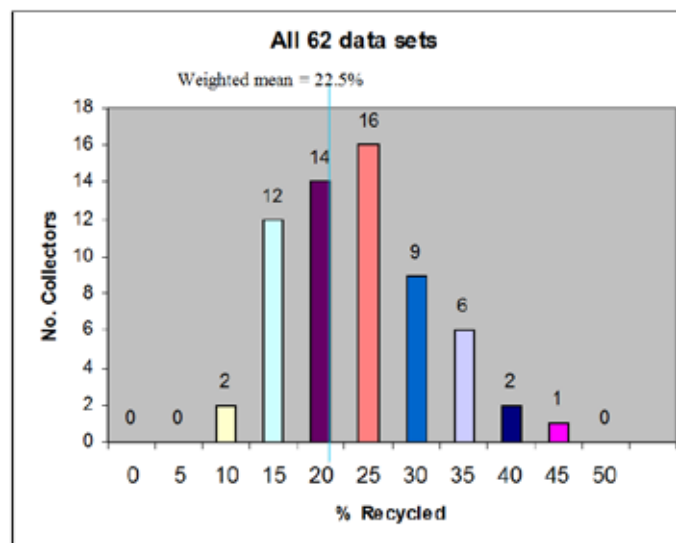


Figure 4.1.8. All 62 data sets recycling data distribution.

#### *4.1.4.5 International literature*

The assessment of the PBU literature uncovered a wide range of experiences in different regions not only with PBU charges as a whole but also within each system. Within each PBU system, the impacts upon recycling levels are varied and there is little evidence to reveal one PBU system as reliably more effective than the others in increasing householder recycling. Research conducted by Bauer and Miranda (1996), Callan and Thomas (1997), Ferrara and Missios (2005) Hong *et al.* (1993), Hong (1999), Kipperberg (2007), Linderhof *et al.* (2001), Miranda and Aldy (1998), and Sterner and Bartelings (1999), found that PBU charges can increase the probability that a household recycles frequently. In addition, Canterbury (1998) reported on a study conducted by the Institute for Local Self-Reliance (ILSR) that examined several communities in the US achieving a 50% recycling rate, and found that more than half of the sampled communities credit PBU for their success. A 1996 review by Miranda *et al.* of the PBU literature outlines a 1993 survey of 1,000 local recycling coordinators in the US, in which the respondents identified PBU charges as the most effective strategy for encouraging recycling. PBU charges received a 3.83 on a scale of 1 to 5 (5 being most effective at encouraging recycling) (Khutor and Huffman, 1993, cited in Miranda *et al.*, 1996).

In contrast, however, Dijkstra and Gradus (2004), Fullerton and Kinnaman (1996), Kinnaman and Fullerton (2000) Jenkins *et al.* (2003), Reschovsky and Stone (1994) and Van Houtven and Morris (1999) found that PBU charges or types of PBU *do not influence* household recycling levels.

Nonetheless, although recycling figures overlap substantially in the international literature into PBU charges and recycling, all studies into the relationship between weight-based charges and recycling levels found that this PBU system impacted positively upon recycling, whereas two international studies examining tag-based charges, and four studies examining differential bin size charges, concluded that these forms of PBU did not alter recycling rates.

In Ireland it was found that weight-based charges resulted in the greatest diversion to recycling, with tag-based and differential bin size charges both prompting the same diversion rates.

#### **4.1.5 Comparing the Environmental Outcomes of the Various Pay-by-use Systems**

##### *4.1.5.1 Total waste presented at kerbside*

The average tag-based household presents less waste at the kerbside in total than the average household using weight-based or differential bin size charges. The average figures were 928kg (tag-based), 947kg (weight-based) and 1,294kg (differential bin). However, a statistical analysis shows no real difference between tag- and weight-based systems in this regard. Also, when the different weight-based systems are considered, the per kilogramme weight-based charge system showed an average per household total waste figure of 800kg per annum, lower than any of the others.

However, when the range of figures is examined it can be seen that tag-based charges have achieved the single lowest figure per household for total waste, with 596kg experienced at the lower range of tag-based charges; weight-based charges experienced a low of 646kg and differential bin charges experienced a minimum figure for total waste of 777kg per annum for one region.

At the upper range of total waste presented, a weight-based charging area showed the lowest maximum figure for total household waste, 1479kg, followed by tag-based charges, 1890kg, and differential bin charges experiencing the highest single overall regional figure, 2246kg.

##### *4.1.5.2 Residual waste*

On average, householders in weight-based areas placed 72% of their total presented waste into the residual waste bin. In comparison the tag-based householders placed, on average, 79% of waste in their residual waste bin, and the differential bin size householders also placed 79% of their total waste in this bin.

##### *4.1.5.3 Kerbside recycling collection*

The data showed that households using a weight-based charging system had a higher rate of recycling than households in either tag-based charging systems or differential bin size systems, with an average of 27%, to an average of 20% for the tag-based collectors and 21% for the differential bin size collectors. The per kilogramme system showed an average household recycling rate of 32%. [Table 4.14](#) summarises the findings on the three PBU systems.

**Table 4.1.4. Comparing pay-by-use (PBU) systems using average figures per household.**

	Percentage residual waste	Percentage recycling	Total waste per household (kg)
Per kilogramme weight based	65	32 <sup>15</sup>	800
All weight based	72	27	947
Tag based	79	20	928
Differential	79	21	1,294

#### **4.1.6 Comparing Local Authority and Private Collectors with Pay-by-use Systems<sup>16</sup>**

##### *4.1.6.1 Waste disposal*

From the data received, local authorities outperform private waste collectors in reducing the amount of waste presented as MSW for disposal at the kerbside. The amount of waste in residual waste bins is greater under private waste collectors, and this applies to the two PBU systems available for comparison (weight-based and tag-based systems). Differential bin size PBU systems could not be compared because data were not available from local authorities in 2008 when the data was taken, and only one public collector uses this system exclusively.

Households using a private weight-based collection present on average 15% more of their total waste in their residual waste bin than households using a local authority weight-based collection – 76% of total presented waste in comparison to 61%.

Households with a tag-based collection charge present on average 84% of their waste in the residual waste bin if using a private collection service, and 74% if using a local authority collection service.

##### *4.1.6.2 Kerbside recycling collection*

The data shows a greater percentage of total waste at the kerbside being presented for recycling by local authority collector households than by private collector households. However, this difference is greater under

weight-based systems than tag-based systems. Under weight-based systems the average percentages of total waste presented for recycling for private collector households is 24%, whereas this figure is 33% for local authority households. Households with a tag-based system run by a private collector present on average 16% of their waste in their recyclables bin as opposed to 21% for local authority households.

One reason for this disparity in weight-based systems is that local authorities tend to use a weight-based system with households paying an annual service charge plus a per kilogramme charge. Only one private collector surveyed used this form of 'pure' weight-based charging. However, two additional forms of pay-by-weight were also used by the private waste collectors surveyed. These are a 'banded' weight-based system and an 'average weight' weight-based system. The 'banded' weight-based system uses several weight brackets that an annual bin weight may fall within, with a different price for each weight bracket. The 'average weight' weight-based system uses a calculated average household waste presentation rate (commonly 800kg per year). If a household produces less weight than this average they receive a reduction on their next annual bill and if a household produces more weight than this average they are billed for the additional weight.

The findings of this study indicate the per kilogramme form of weight-based charging system is more effective than the 'average' and 'banded' systems at encouraging recycling. This finding prompted a comparison of figures under 'average' and 'banded' weight-based systems, to determine if the three forms of weight-based charging used could be placed in 'order of success' in terms of prompting waste recovery.

Although exact details of the charges used were not available for all privately operated weight-based systems, the form of weight-based charge was known for 12 data sets; 9 'average' weight and 3

15 Note that the residual waste and dry recycling rates do not add up to 100% due to the fraction of organic waste also collected separately in tag and weight-based areas.

16 Note: Caution should be taken when considering these data since the data sets are not very large. The numbers of local authority weight-based collectors: 5; private weight-based collectors: 17; local authority tag-based collectors: 8; private tag-based collectors: 6.

'banded' weight data sets. Under an 'average' weight system 20% of kerbside waste was presented in the recyclables bin, and under a 'banded' weight system 26% was presented in the recyclables bin.<sup>17</sup> The low recycling rate under an 'average' weight charge may be due to the delayed reward for recycling within this system, with householders waiting for the following year's bill before seeing a saving as a result of their waste management behaviour.

#### 4.1.6.3 Total waste presented at kerbside

The total waste in kilogrammes presented by households at kerbside was lower for local authority collector households than for private collector households. Under weight-based systems the average total waste presented at the kerbside for private collector households was 1,040kg, and for local authority collector households it was 768kg, a difference of 272kg or 35%. This difference in total waste levels may be caused by the delayed reward for reducing waste to residual bins in weight-based systems used by private collectors, as outlined above. As mentioned previously, there are also three systems within the weight-based PBU. Private collectors tend to use the average or banded PBU systems, while local authorities tend to use the per kilogramme system – this could, at least partly, account for this large difference.

Tag-based system households using private collectors' waste services presented, on average, 1,192kg of total waste per annum at the kerbside, whereas local

authority serviced households presented, on average, 912kg per annum – a 280kg difference per household annually. It is not clear why local authority customers would present less waste than private customers when both use similar charging systems. Since limited data were available on price per tag for private collectors, it is not possible to state definitively that households with a private collector are charged less to place out waste than local authority households.

A disparity is again found with regard to residual waste,<sup>18</sup> with higher percentages of waste being left for disposal by households using a private collector than those with a local authority service, for both tag (76% to 64%) and weight-based (84% to 80%) systems.

#### 4.1.6.4 Conclusions regarding private versus public PBU systems

Households with a local authority waste collection service present substantially less total waste than those with private waste collection services. They also present less residual or MSW waste, and have higher recycling rates, as [Table 4.1.5](#) shows. This indicates that PBU systems as implemented by local authorities have a better environmental performance.

The large differences between the local authority and private weight-based collectors may also be exacerbated by the differences in per weight systems being used. Per kilogramme weight systems are more common in local authorities.

**Table 4.1.5. Comparing PBU systems for local authority and private collectors using average figures per household.**

	Disposal rate (%)	Recycling rate (%)	Total waste (kg)
Local authority collectors:			
weight based	64	33	768
Private collectors: weight based	76	24	1,040
Local authority collectors:			
tag based	80	21	912
Private collectors: tag based	84	16	1,192

17 As only three data sets were available under a 'banded' weight system, these figures should be treated with caution.

18 Again the disposal rate data discounts those areas with separate organic waste-collection systems, giving disparities in the percentage totals.

#### **4.1.7 Summary and Conclusions**

As [Table 4.1.4](#) shows, the 'per kilogramme' weight-based charges are the most effective PBU system from an environmental perspective. These charges have prompted the highest diversion rates from landfill and the lowest total kerbside waste figures. Households with a 'per kilogramme' weight-based system also present the least waste at the kerbside. The 'average weight' system showed results similar to tag-based with regard to total volumes of waste but performed better with regard to recycling when the three weight-based systems are considered separately. The differential bin system indicated the least environment effectiveness of the three systems, especially with regard to the total waste volumes presented. Overall, PBU systems as implemented by local authorities have better environmental results than those implemented by private collectors.

## **4.2 Impact of Pay-by-use Systems on the Waste Collector**

A large-scale interaction with domestic waste collectors was carried out with the aim of examining PBU systems from all relevant perspectives and developing optimised PBU systems. An optimised PBU system will not only be environmentally successful but will also maintain a properly functioning waste management system. On this basis, waste collectors were contacted to determine how each PBU system functions from an operator's point of view. Collector feedback was gathered using two methods: surveys and face-to-face discussions. Data were gathered from 34 collectors: 15 local authority and 19 private, implementing 47 different PBU systems in all. Information was gathered from 21 collection systems using tag-based charging, 13 systems using weight-based charging, and 13 systems using differential bin size charging, with many collectors using more than one PBU system. The discussions explored each collector's experiences of their PBU system, looking at all aspects of the initial set-up and the day-to-day running of the system, and their opinions on an optimised system.

Section 4.2.1 outlines the findings of the impacts of PBU systems on waste collectors. This section examines each of the three studied PBU systems separately: first tag-based systems, then weight-based systems, and finally differential bin size systems. The questions put to waste collectors centered on three key areas: (i)

the cost effectiveness of the system, (ii) the collector satisfaction with the system, and (iii) the advantages and disadvantages of the system. Waste collectors were asked whether they found their PBU system to be more or less cost effective to run than a flat-rate system. They were asked how satisfied they were with their selected PBU system(s), whether or not they would recommend their system to other waste collectors, and whether they were considering moving to a different PBU system in the future. Collectors were also asked to outline the main advantages and disadvantages of their chosen system. These themes were further developed in the face-to-face discussions. This allowed more detailed and focused information to be gathered on some topics, resulting in a deeper understanding of the more relevant issues involved.

Section 4.2.2 covers other issues of concern to waste collectors. During discussions with collectors several issues were raised which – although not directly related to PBU – nonetheless have an impact upon the provision of a waste collection service. These additional issues are outlined in this section.

Section 4.2.3 describes an optimal PBU system from the perspective of waste collectors. Following face-to-face discussions with waste collectors, a number of key components for an optimised system were identified. These components are outlined, followed by a summary of the main issues that arose when collectors moved to these optimised systems.

Finally, Section 4.2.4 summarises all the information gathered on this topic.

### **4.2.1 Impacts of PBU on collectors**

#### *4.2.1.1 PBU system: tag-based*

##### **4.2.1.1.1 Cost effectiveness**

All waste collectors were asked whether they considered their selected PBU system to be more or less cost effective to administer than a flat-rate system. Seven tag-a-bin collectors, two pay-per-lift collectors and three tag-a-bag collectors answered this question.

Of these 12, 10 collectors (83%) stated that their tag-based system is more cost effective than a flat-rate system. Both pay-per-lift collectors and the tag-a-bag collectors considered their waste collection systems to be more cost effective than a flat-rate system. In addition, the majority of collectors considered tag-a-

bin as more cost effective to administer than a flat-rate system, with five collectors giving this answer. Two tag-a-bin collectors considered this system as less cost effective to administer than a flat rate system.

#### **4.2.1.1.2 Satisfaction with the systems**

Local authorities and private waste collectors using a tag-based system were asked several questions to establish their satisfaction with their system. They were asked directly whether they were satisfied with their tag-based system; whether they would recommend the use of tag-based systems to other waste collectors; and whether they were considering moving to a different PBU system in the future.

Six tag-based collectors responded to the question on satisfaction. There was a mixed response: two collectors stated that they were satisfied with their system, and four expressed dissatisfaction.

Despite this finding, 9 of the 12 waste collectors stated that they would recommend the use of tag-based systems to other waste collectors. One collector recommending the system felt that it was a good option for a small community, or for a small collector. Of the 3 collectors who would not recommend this system, 1 felt that an annual or six-monthly charge would be preferable from waste collector's perspective. A second felt that the system provided little annual income per household.

Waste collectors were also asked whether they were considering moving to a different PBU system in the future. Seven stated that they were not planning to change their PBU systems, one stated that it was considering switching to another system,<sup>19</sup> and one was unsure, stating that it depends upon the other competition within the area.

The collector considering adopting a different PBU system stated that it was doing so due to 'competitive pressures, cost and customer inconvenience'. In addition, two of the local authorities that are not planning to adopt a different system were still planning to make changes to the way they operate the tag-a-bin system.

One of these local authorities is currently moving from a traditional tag-a-bin system to an automated advance

credit system. Householders will be able to go online and purchase credit, and this will make the system more convenient, though householders still have the option of buying credit for the system in a local shop as they did with tags. This automated system will also have advantages from the collector's perspective: it will remove the cost of producing and distributing tags and will provide data on the number of lifts per collection route, allowing for better planning in the future. At least one other tag-based local authority (based in an urban area) uses publicly accessible machines to issue these tags (as well as from retailers). These machines can be accessed '24/7', thus ensuring that every householder in theory can access a tag before they put their bin out. Other local authorities stated that the accessibility of tags, especially in rural areas, was a problem and the administrative difficulties of getting tags to retailers and getting paid by the retailers was also causing difficulty.

A second local authority is planning to restructure its tag-a-bin charges, by altering the cost of the service charge and the bin costs. This local authority currently charges households for the bin tags required for the recycling and the organic waste bins as well as for the residual waste bin. This collector is restructuring its system to focus charges on residual waste only, by increasing this tag charge and removing the charge on recycling and organic bin presentation. The aim of this move is to improve presentation rates for the organic waste bin.

However, despite the fairly high satisfaction levels reported in the survey and the initial meetings with collectors, the more recent follow-up meetings revealed a somewhat different opinion. A year after the initial opinions were gathered (2009) a number of collectors were revisited in 2010 with additional questions on their systems. This was to determine their current experiences, since many changes have occurred in Irish domestic waste management during the period 2009/2010 and several issues had arisen in the first set of results that required further analysis.

In these follow-up discussions, pay-per-lift collectors were still expressing satisfaction, but some tag-a-bin collectors stated that they are now considering moving away from their system. Tag-a-bin collectors are either currently moving, or intending to move in the future, towards automated systems such as pay-per-lift and weight-based systems. The majority of tag-a-bin collectors questioned felt that there were significant

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19 This local authority now offers an annual flat fee as well as a tag-based system.



drawbacks with this manual tagging system, with several collectors referring to tag-a-bin as a 'nightmare'. The main issues were: the manual nature of the system; a very large administrative burden; difficulties regarding waivers and discount costs; fraud problems; difficulties with the staff collecting the waste and the tags; and a lack of information about their customer base. Only two collectors were not entirely negative about the system. However, one of these is in the process of moving to a pay-per-lift system and the other intends to move once it is more comfortable in its long-term continuation of a waste collection service.

#### 4.2.1.1.3 Advantages and disadvantages

All waste collectors were asked to outline a list of the pros and cons of tag-based systems in the questionnaires. These are listed in [Table 4.2.1](#).

However, many of the advantages and disadvantages listed by collectors are contradictory. For example,

tags are considered both cumbersome to administer but other collectors state that administration is not difficult. In addition, one collector cites simplicity as an advantage and another says the system is cumbersome. The experiences of different collectors may depend upon issues such as the size of the customer base, the differences between urban and rural areas, and different socio-economic factors.

A large number of advantages were listed for tag-based systems but the main advantages can be summarised as:

- A regular and in advance payment for collection service (applies to tag-a-bin and not pay-per-lift);
- Clear and easy for customers to use;
- Incentivises positive waste management actions;
- Uses simple technology;
- Cheap and simple to administer.

**Table 4.2.1. Advantages and disadvantages of tag-based domestic waste charging systems.**

Advantages of tag-based systems	Disadvantages of tag-based systems
Simplicity	Inconvenience for customers in purchasing tags
Low administration costs (if tag-a-bin or tag-a-bag)	Costs of recording lifts, billing, debt collection (if pay-per-lift)
Fair and equitable	Tags can be interfered with on bins
Incentivises waste minimisation	Cost of tag administration
Administration is not difficult	Bins being presented less frequently. Sending trucks down roads looking for bins which may not be presented.
Encourages recycling	Customers may forget to buy and difficult to dispose of subsequent week's waste
Consistency with Polluter Pays Principle	Without an annual charge there is no customer database
Minimises the number of collections required	Bin very full/heavy when presented for collection
Provides regular income for service provider	Encourages excessive storage of waste
Payment in advance means no arrears to be pursued and no bills to invoice	Tags cumbersome to administer
Visible to householder continually, continual reminder of volume of waste produced throughout the year	Crew can lift bins without tags, they can be accused of taking money to lift bins without tags or allowing households to reuse tags
Very simple technology	Not possible to get any information on the weight of bins presented for collection
Easy for customer to use	Compaction and smell issues with bins being presented infrequently
	No reliability of income when operating without a service charge
	Delivery of tags to shops, counting tags, compiling lists of customers using handwritten tags
	Paying commission to shops to sell your tags

The main disadvantages can be grouped into three categories:

- The administration and manual handling of tags for collectors and customers (applies to tag-a-bin and not pay-per-lift);
- Lack of customer data (applies to tag-a-bin and not pay-per-lift);
- Insecurity of income; and
- too much weight in bins.

When the more recent discussions with tag-a-bin collectors were conducted, the disadvantages weighed heavily on the collectors. In the current competitive waste collection market a lack of customer data was considered to be a significant drawback of the tag-based system. Lack of data impairs the ability of the waste collector to optimise their service by altering and rationalising routes. The heavy weight of the residual bins was also considered an issue, particularly considering proposed increases in the landfill levy. The printing of tags, manual handling of tags, distribution of tags to shops, collecting and managing of tags from lifted bins and so on all add to the administrative burden of the tag-a-bin system. Although some collectors still stated that they found tag-a-bin systems easy to administer, the majority had a contrary experience. However, the advantage of advance payment was still considered very valuable to collectors, and the main advantage of the tag-a-bin system.

While the numbers of advantages and disadvantages of this system in [Table 4.2.1](#) initially appear to be similar, it is clear from the most recent interviews that many waste collectors are currently dissatisfied with tag-a-bin based systems and that the disadvantages outweigh the advantages. Pay-per-lift systems do not have the problems of lack of data or manual administration, though the issue of heavy bins still applies to this pay-by-volume system. Pay-per-lift has the additional disadvantage of post-service billing, with the associated problems of customer debts. Overall, collectors are more positive about pay-per-lift, considering it a worthwhile compromise between tag-a-bin and a weight-based system.

The review of the international literature on tag-based PBU waste charges mirrored many of the advantages and disadvantages of the system found in Ireland. The literature indicates that:

- Tag-based systems are cheap to set-up and run;
- Tag or tag programmes also eliminate the need for a billing system and revenues are received ahead of service delivery, as waste service is 'pre-paid' when the tag is purchased;
- These systems only require a small staff to distribute tags/bags and track bag and tag sales.

However, the literature also reported that revenue uncertainties are relatively high under a tag-based system, as a householder might buy several months' worth of bags at one time and then none for many weeks, though this can be countered by the presence of a fixed charge which can reduce revenue volatility (Cantebury, 1994).

#### *4.2.1.2 PBU system: weight-based*

##### **4.2.1.2.1 Cost effectiveness**

All waste collectors were asked whether they considered their selected PBU system to be more or less cost effective to administer than a flat-rate system. Six collectors using a weight-based system answered this question. Five of these considered their weight-based charging system as more cost effective to administer than a flat-rate system. Once the initial set-up costs for chips, trucks, information technology and so on have been paid, the ongoing costs are not prohibitive. There are ongoing costs in relation to software and hardware provision but once the software system is up and running it was found to be 'manageable' and it also provides very good data which the local authorities find useful for decision-making and planning.

##### **4.2.1.2.2 Satisfaction with the system**

Nine collectors using a weight-based system responded to the questions on satisfaction with the system. All nine felt satisfied with their use of a weight-based system, would recommend it, and are not planning to move to another PBU system. The reasons provided for satisfaction were that it is easy to track bins and gather data on customers (the customer name can be typed in and information obtained on frequency of presentation, weights presented, etc.); that waste collectors are charged by weight at the landfill; therefore, charging households by weight makes sense as they cover their waste costs; and that bins are placed out frequently and so there are no smell or overfilling issues. Several collectors expressed disappointment that weight-based charges were not being implemented by other collectors.



The weight-based collectors felt that this system should be recommended owing to the environmental results of the system, the data gathered on household weights, and the rewards to low-waste-producing households. One respondent felt that initially they understood that the government was going to insist that pay-by-weight be applied universally in the country and this was the main reason for choosing that system. Another collector, although satisfied with the system in general, has experienced difficulties with contamination of the recyclables bin.

#### 4.2.1.2.3 Advantages and disadvantages

Waste collectors were asked to outline a list of the advantages and disadvantages of weight-based systems. These are listed in [Table 4.2.2](#).

Here the disadvantages appear to outweigh the advantages, but collectors using the system said they would recommend pay-by-weight. Many of the disadvantages are at the initial stage of set-up: costs, difficulty for customers to understand, bin-registration issues and so on.

However, it is clear that some local authorities feel they are losing customers because of these charges. Another problem with pay-by-weight is that the payment is 'after the event' and this is a particular concern for many collectors (especially local authorities) in view of the difficult current economic period. People may

have difficulty paying all their bills, not alone those relating to waste. The advantage of tag a bin, or a flat fee, is that the payment is up-front, there is no post-collection billing and thus no arrears. The costs associated with trying to get arrears and payments are very high and payback is seldom achieved.

Many of the disadvantages of pay-by-weight appear cost related (notably up-front costs and post-service billing), while the advantages are mainly environmental in nature and may be considerable.

The international literature also reported that weight-based systems tend to be more expensive to implement and operate than differential bin size and tag-based systems. The system requires specialised waste collection trucks with weighing equipment, bar-coded waste bins, and complex intensive billing systems. However, the literature did indicate that weight-based systems may be more effective in encouraging households to divert waste from landfill/incineration than differential bin size and tag-based systems since every kilogramme of waste that residents prevent, recycle, or compost results in direct savings. These reductions in unsorted waste presentation levels will result in reduced landfilling or incineration costs to the waste collector. Weight-based systems also provide a more precise measurement of waste generation than other PBU systems (Cantebury, 1994).

**Table 4.2.2. Advantages and disadvantages of a weight-based domestic waste charging system.**

Advantages of weight-based charges	Disadvantages of weight-based charges
Implements very strict Polluter Pays Principle	Expensive to set-up
Encourages diversion of organic waste and recyclables away from landfill	High level of technology; system introduces a degree of complexity involving calibration of load cell weighing mechanisms
Transparent to customers	Bin registration issues
Gathers accurate data on weights and frequency of presentation; can plan waste collection more efficiently.	Post-service billing can lead to arrears and using resources to pursue these
Allows for black listing of customers who do not pay charges, preventing 'free riders'	Difficult to compete on price alone
	Unless it is universal in the region, clients inclined to take the easy option
	Requires a high degree of commitment by collectors
	Difficult for public to understand a complex charging system
	Could be expensive for customers depending on waste types generated

Studies have also indicated that when households are charged based only on the weight of waste they present they may select to place the bin out for collection even when it is not full. This increases collection costs to the collector. An area in Germany has avoided this problem by charging householders based both on the weight of the waste but also on the frequency of collections (Hogg, 2002).

#### *4.2.1.3 PBU system: Differential bin size system*

Despite survey responses from 13 collectors using a differential bin size system as either their only PBU system or as one of their PBU systems, very little feedback was gathered from collectors on this system. Many of the questions were unanswered, and where answered often referred to the other PBU systems offered rather than the differential bin size system.

##### **4.2.1.3.1 Cost effectiveness**

There was no response to questions on cost effectiveness from collectors operating this system but since it is widely offered and entails a once-off prepayment, it can be assumed that collectors find it cost effective.

##### **4.2.1.3.2 Satisfaction with the system**

Three collectors that responded were satisfied with this system, would recommend it to other collectors, and are not considering moving to another system. Two other collectors, although satisfied with the system, are planning to move towards a weight-based system as it is the most accurate in terms of charging households for the waste they produce, and changes in recent years have resulted in an improvement in the technology and reduced costs of implementation. Several collectors offered a differential bin size service to customers alongside other PBU systems. These

collectors feel that households that have no intention of recycling will select a differential bin size system when given the choice between several systems. This suits the collector as these households may select to contaminate the DRF bin if they used a tag or weight-based system, which is a problem for the collector. These collectors are satisfied with a differential bin size system as a complementary system to other PBU systems used.

The reasons provided for satisfaction with the differential bin charge were: easy and cheap to operate and manage can promote recycling by altering collection frequency of MSW bin and DRF bins or by offering small minimum MSW bin sizes at a noticeably lower price than larger MSW bins; waste does not build up as it is put out regularly. Several collectors also felt that customers, particularly those that produced large amounts of waste, enjoyed the convenience of the system, with a simple fixed payment and no concerns over the uncertainty of bills.

The international literature reported that differential bin size systems are associated with ease of implementation as they generally do not require waste collectors to make many changes from previously used flat-rate systems (many of the bins already in use can continue to be used and the same waste collection trucks are also suitable). In addition, differential bin size systems are easy from a billing perspective and ensure secure revenue. However, they may not result in large reductions in residual waste levels.

##### **4.2.1.3.3 Advantages and disadvantages**

Waste collectors were asked to outline a list of the advantages and disadvantages of differential bin size systems. These are listed in [Table 4.2.3](#).

**Table 4.2.3. Advantages and disadvantages of a differential bin size domestic waste charging system.**

<b>Advantages of differential bin size charges</b>	<b>Disadvantages of differential bin size charges</b>
No extra costs to contractor	No encouragement to recycle
Easy to maintain and implement	Customer pays for bin whether full or half full
Guaranteed annual income	Less attractive to the customer from a financial point of view
Easy for billing, every customer gets the same bill	Not charging enough for heavy bins
No investment in weighing equipment	Unfair on households with less rubbish
Money collected in advance	
Can encourage recycling and waste reduction if a small minimum bin size is offered for residual waste	

## 4.2.2 *Summary of the Impacts of the Various Pay-by-use Systems on Waste Collectors*

### 4.2.2.1 *Cost effectiveness*

On the whole, those surveyed have indicated that both tag- and weight-based systems appear to be more cost effective to run than a flat-rate system, with five of the six weight-based collectors that responded to the question and ten of the twelve tag-based collectors that responded to the question stating their system is more cost effective than a flat-rate system. However, two of the twelve tag-based collectors and one of the six weight-based collectors said that they found their system less cost effective to run than a flat-rate system. Information was not provided on this topic by differential bin size collectors. It is not clear from the study which of the three systems is the most cost effective as running costs per-customer were not provided.

### 4.2.2.2 *Satisfaction with their system*

- Collectors using a differential bin size system were largely satisfied with this system although some collectors would prefer to move towards a weight-based system;
- Several collectors using a tag-a-bin system were found to be dissatisfied on the whole with their PBU system and would prefer to move to a lift-based or weight-based system;
- Pay-per-lift collectors were satisfied with their system but are aiming towards a weight-based system in the longer term;
- Weight-based collectors are satisfied with their system on the whole but can experience problems with post-service payment. However, it does appear that some collectors are beginning to offer flat-rate systems as well as their tag- or weight-based systems.

### 4.2.2.3 *Advantages and disadvantages of the different systems*

The advantages and disadvantages of the three PBU systems (listed in [Tables 4.2.1](#), [4.2.2](#) and [4.2.3](#)) can be grouped under several main issues that are of concern to waste collectors: cost, administrative burden, ease of collection, level of technology required, data-gathering, customer perspective, and the environment.

- **Cost:** Tag-based systems are commonly considered a low-cost option, and this was listed by some as a cost-effective option. Others, however, consider it costly, citing the cost of tag production in the case of tag-a-bin and tag-a-bag, the cost of purchasing and distributing recycling bags, and the costs of recording lifts, billing, and debt collection in the case of pay-per-lift. Differential bin size systems are cheap to implement and to run. Weight-based charges were considered expensive by all respondents, particularly with regard to the set-up costs.
- **Administrative burden:** There were mixed reports of the administrative burden under tag-based systems. Some respondents stated that administration is easy, and that payment in advance means no arrears to be pursued (this excludes pay-per-lift systems). Other respondents stated that tags are cumbersome to administer. However, following further discussions with tag collectors it was found that the majority of collectors consider tag-based systems inconvenient to administer. The only negative comment on the administration required under a weight-based system was that post-service billing can lead to arrears and the use of resources to pursue these arrears. This may increase as families find themselves in financial difficulties over the coming years. Otherwise, the automated nature of the system reduces administration. Collectors using a differential bin size system found this system administratively easy, with the same bill sent out to most customers and advance payment.
- **Ease of collection:** Tag-based systems were considered advantageous in terms of ease of collection as the charging system encourages households to wait until their bin is full before presenting it for collection. This minimises the number of collections required by the waste collector, reducing their costs. However, this may also encourage excessive storage of waste and these bins can be very full/heavy when presented for collection. No comments were made on this issue for weight-based systems or differential bin size systems – perhaps indicating there were no perceived problems.

- **Level of technology required:** An advantage of tag-based systems (particularly tag-a-bin and tag-a-bag) and the differential bin size system is the use of very simple technology. This simplicity is one of the main factors that attracted tag-based and differential bin size collectors to these systems. Weight-based systems have the disadvantage of requiring a high level of technology. The weight-based system introduces a degree of complexity involving calibration of load-cell weighing mechanisms. In addition, waste collectors using a weight-based system have experienced problems with bin registration. Overall, however, those with pay-by-weight appeared satisfied with the information technology and software associated with it.
- **Data-gathering:** A significant problem for tag-based systems is the lack of data on customers (this applies to the tag-a-bin and tag-a-bag systems and not pay-per-lift). Tag-based systems that operate without an annual service charge do not have a customer database and collectors do not know how many customers they have. In addition, when using tag-based systems it is not possible to get any information on the weight of bins presented for collection. Data-gathering is a considerable advantage of weight-based systems. These gather accurate data on weights and frequency of presentation, allowing collectors to plan collection more efficiently. No information was provided on data-gathering under a differential bin size system.
- **Customer perspective:** From the householders' perspective, tag, weight and differential bin size systems have both advantages and disadvantages. Collectors feel that tag-based systems present more advantages to the customer. Proponents of tag-based systems state that tags are easy for customers to use, fair and equitable, and that the system is simple. On the other hand, collectors pointed out the inconvenience for customers in purchasing tags in some (mainly rural) areas; that continuous payment for tags may be seen as difficult by customers; that customers may forget to buy tags and – if this occurs – households may find it difficult to dispose of subsequent weeks' waste. Waste collectors also reported that tags can be interfered with on bins – though the prevalence

of this does not appear to be widespread. While some collectors feel that the weight-based system is transparent to customers and they have had no problems with householders, conversely other collectors consider it as a complex charging system that is difficult for the public to understand (especially in the set-up phase). Another disadvantage listed for weight-based systems is that this system could be expensive for customers depending on waste types generated. Collectors offering a differential bin size system feel the certainty of waste costs is an advantage to customers, but the charge may be perceived as unfair by households producing small quantities of waste.

- **Environment:** Waste collectors using tag, weight and differential bin size systems consider their system consistent with the 'Polluter Pays Principle', and feel it sends out signals to households to reduce waste to landfill, and increase waste diversion. The charges issued under a tag-based system are also considered visible to the householder and a continual reminder of volume of waste produced throughout the year. However, weight-based charges implement the Polluter Pays Principle very accurately and transparently.

#### *4.2.2.4 Conclusions*

From the waste collectors' perspective, tag-a-bin and tag-a-bag are the least preferable PBU systems for implementation. Pay-per-lift and weight-based charges are the optimal systems from the perspective of large waste collection companies or local authorities. These large collectors are selecting to use automated systems, as automation allows collectors to move easily to lift or weight systems. There is no clear preference for either pay-per-lift or weight-based charges. Pay-per-lift presents the problems of heavy bins, does not gather as much information as weight and is also not as environmentally effective as weight. Pay-per-weight systems have the disadvantage of being more costly to introduce and less clear to households. Nonetheless, both systems are effective environmentally; both enable the gathering of customer data, allowing for future planning; and both have a low administrative burden. Nevertheless, small waste collection companies and some local authorities say they cannot afford to move towards automated systems and from their perspective a differential bin size system may be optimal.

### 4.2.3 Other Issues of Concern to Waste Collectors

During discussions with collectors several issues were raised that, although not directly related to PBU, nevertheless have an impact upon the provision of a waste collection service and merit reporting. These additional issues are detailed below and include the following:

- Private versus public collection;
- Waivers;
- Future security;
- VAT
- Ability to change service rapidly;
- Organic waste (brown) bin;
- People opting out of collection service.

#### 4.2.3.1 Private versus public collection

Although this was not discussed overtly in the questionnaire sent to local authority collectors, the pattern of customer loss seen in the data (and shown in [Table 4.2.4](#)) shows clearly that many of the local authorities are losing paying customers to private collectors. A move of customers from public to private

collectors may affect waste-presentation rate on a national level. As seen in Section 4.1.5 households using a local authority collection service present less total waste than those using a private collection service, and also have higher recycling levels. Based on these findings, a loss of customers from local authority services to private services could have consequences in terms of meeting national waste targets.

Some of the trends shown may stem from demographic reasons (and increases would be expected since the population and housing numbers have been growing in recent years). However, for various reasons, it also seems clear that some local authorities are struggling to compete with their private counterparts.

Following the introduction of PBU charges, household numbers remained stable in three local authorities, two of which were tag-based and one of which was weight-based. Three local authorities experienced a decrease in household numbers, and three experienced an increase. Two of the three local authorities with a decrease in customer numbers use a weight-based charge. All three collectors with an increase in customer numbers use a tag-based system.

**Table 4.2.4. Percentage change in customer numbers in local authorities.**

Local authority	Change in customer numbers following introduction of PBU charges (%)	Change in customer numbers from earliest to latest figures provided (%)
Tag-a-bin local authority 1	13.2 decrease	22.7 decrease
Tag-a-bin local authority 2 <sup>20</sup>	31 increase	51.7 increase
Tag-a-bin local authority 3 <sup>21</sup>	4 increase	7.7 increase
Tag-a-bin local authority 4	Figures not provided	1.7 decrease
Tag-a-bin local authority 5 <sup>22</sup>	Figures not provided	43 decrease
Tag-a-bin local authority 6	No change	No change
Pay-per-lift local authority 1	5.8 increase	6.8 increase
Pay-per-lift local authority 2	No change	No change
Weight-based area 1	5.5 decrease	10.4 decrease
Weight-based area 2	0.5 decrease	19.7 decrease
Weight-based area 3	No change	48.5 decrease
Weight-based area 4	Figures not provided	8.8 decrease
Different bin charge local authority 1 <sup>23</sup>	Figures not provided	27.9 increase

<sup>20</sup> This is a fast growing urban area, but these increases are startling and are uncommon.

<sup>21</sup> Another fast growing urban area.

<sup>22</sup> This is a mainly rural area with losses to private collectors and also to people opting out of any system.

<sup>23</sup> This increase could be mainly due to a reallocation of boundaries in 2005 which caused a large immediate increase in customers. Also the data for this region are spread over a long time period (1994–2008) and demographic and population growths are inevitable over such a long period.



Seven local authorities have experienced a decrease in the number of households they serve over time, with decreases ranging from 1.7% to 48.5%. Although the local authority with the largest decrease offers a weight-based system, the second largest decrease, 43%, is under a tag-based system.

Four have found an increase in customer numbers, and two have found their customer numbers have remained stable. Of the four local authorities with an increase in numbers, two are large urban areas that would have seen significant increases in the local population in recent years. One of the collectors with an increase in customer numbers is the local authority offering a differential bin charge; this may possibly indicate a preference for this system by households.

It is interesting that no weight-based local authority has experienced an increase in customer numbers despite the fact that this is the most environmentally friendly option. It would appear that some householders, at least, do not find this system (or the prices charged) attractive.

There are many potential reasons for householders leaving local authority-provided waste-collecting systems, but what is of concern is the possibility that PBU charging systems are a factor. Another factor mentioned by the local authorities themselves was the issue of waivers discussed below whereby people previously using private collectors are becoming eligible for waivers and then join the publicly provided service as a result. If there were no waiver schemes, the numbers moving to private collectors would undoubtedly be higher. Furthermore, it should be noted that if the data included paying customers only, the decreases in numbers of local authority clients shown in [Table 4.2.4](#) would be greater.

In discussions, local authorities were asked about the charging systems offered by private collectors in their regions, which may be encouraging households to move to private service providers.

In one area, a private collector is offering households the chance to pick their own charging system, offering every system (differential bin, tag-a-bin, tag-a-bag, and weight) as a possible choice for their customers. It is interesting that this collector has found that very few households have selected to use a weight-based system and that instead the differential bin charge system is most commonly chosen.

In other areas, private collectors are offering differential bin charges and gaining customers, indicating that households may prefer a one-off set charge for the year and do not want the bother of other PBU systems. A further factor prompting moves to private collectors may be the frequency of bin collection, with some private collectors offering weekly collections.

One local authority spoke of the introductory offers used by private collectors to encourage customers to join. Cheap waste collection services were offered by private collectors in its area and householders moved to these collectors. When a critical number of households on a route moved from the local authority's waste collection service, the local authority removed these areas from its collection route. Then, according to the local authority, once its service was withdrawn, the private collectors immediately increased the charges to their customers.

One local authority mentioned in discussions that they were planning to withdraw their provision of a domestic waste collection service as they are making a financial loss in providing it. In addition, since the local authority survey, a further two local authorities have made the decision to end their collection service. These moves out of the domestic waste collection market by local authorities may be a response to competition, though it should be noted that in both cases the collector does not use an annual service charge, which may have resulted in additional financial difficulties for these local authorities.

However, competition can also have positive impacts. One local authority found that private collectors moving into the region had a positive effect as it enabled households in rural areas not served by the local authority to avail of a waste collection service where previously none had been available. Another local authority found that the competition from private collectors forced them to provide a better service to households in order to compete. It may also be, however, that private collectors (for a variety of reasons) are offering better value and service in some regions and householders are choosing their services as a result. Householders would also prefer to have a choice of prices and systems available to them.

The issue of competition was addressed in the *Draft Statement of Waste Policy* (DoEHLG, 2010) which followed on from the *International Review of Waste Management Policy* (Hogg *et al.*, 2009), commissioned by the DoEHLG as part of its objectives outlined under the 2007 *Programme for Government*, and published

in 2009. The draft policy document suggests that local authorities are made responsible for waste collection arrangements and that a competitive tendering process be undertaken to select waste collectors. Local authorities would be free to compete with private collectors for the market, and in this case an independent assessment process would be used. Under this proposed system, all potential collectors would be required to meet specified environmental standards and public provision levels. Any collector competing for the market would have to provide pre-determined recycling frequencies, biodegradable waste collections, and reach per-person residual waste targets.

In the absence of competitive tendering, waivers, future security, VAT and the inability to change rapidly were reasons highlighted by local authorities as issues hindering their ability to compete with private collectors. These issues are examined below.

#### 4.2.3.2 Waivers

Waste-charge waivers are provided by all local authorities that collect domestic waste. These waivers reduce or waive the waste collection charge for low-income households. The topic of waivers was not considered in the questionnaire but it arose as a major issue in almost all of the direct discussions with the local authority collectors, and 12 of the 15 waste collecting local authorities provided data on this topic. Waivers were examined as part of this research as they could influence household waste levels, lead to waste 'migration', and because they were raised as an area of concern by local authorities. One of the reasons put forward by the local authorities regarding the difficulty of competing with private collectors related to waivers, and some local authorities felt that it was so financially onerous as to cause them to consider whether or not to continue to collect domestic waste at all. The numbers of waivers in the different local authority areas questioned on this matter varied from 7% to 37%<sup>24</sup> of customers, with an average of 23% of local authority customers availing of a waiver. [Table 4.2.5](#) details the percentage of customers with a waste charges waiver in the 11 local authorities that provided data on this topic.<sup>25</sup> The figures were gathered in 2009.

<sup>24</sup> Percentages are rounded to the nearest whole number.

<sup>25</sup> A further local authority stated that it does not offer a waiver scheme. In total, 12 of the 15 local authorities collecting domestic waste provided data on waiver schemes.

**Table 4.2.5. Percentage of local authority customers with waste charges waiver.**

Local authority	Percentage of local authorities with a waste-charges waiver
Local authority 1	7
Local authority 2	12
Local authority 3	15–20 <sup>29</sup>
Local authority 4	19
Local authority 5	22
Local authority 6	25
Local authority 7	27
Local authority 8	28
Local authority 9	30
Local authority 10	34
Local authority 11	37

Different areas have different waiver schemes, some of which are quite complex and offer many different types of waivers. While many waivers mean merely a reduction in charges (for example, the standing charge being paid but no cost for collections, or no standing charges and only a cost for collection), in one local authority, 25% of all their customers pay no charges at all. This local authority has stated that this may have to be reconsidered and the value of the waiver reduced. Other local authorities are trying to reduce the cost of the waiver scheme. One collector has selected to reduce the value of the waiver, from providing the service charge and 14 tags a year free of charge to just providing the service charge portion. This collector has considered removing the waiver scheme altogether owing both to the cost of running this system currently and because all new customers joining the local authority service are waiver customers, a trend they expect to see continue owing to the current economic climate in Ireland. Another collector is currently implementing an electronic advanced credit system in the place of tags; one of the advantages listed for this move is the removal of the costs incurred in packaging and posting out tags to all of its customers with a waiver (19%).

[Table 4.2.6](#) outlines the waivers operated by the ten local authorities that provided these data. This shows that most local authorities are either subsidising or removing the standing charge as the main form of waiver.

<sup>26</sup> This local authority did not provide an exact figure for the percentage of customers with a waiver.

**Table 4.2.6. Waste-charge reductions for those qualifying for waiver schemes.**

Local authority	Extent of the waiver
Local authority 1	The full waste charge is waived.
Local authority 2	Currently the standing charge is waived for the year i.e. €185 for large bin and €140 for small bin. The customer has to purchase the tags.
Local authority 3	Waiver customers do not pay the annual service charge but still pay the unit charge (i.e. pay for the weight of the bin).
Local authority 4	The waiver is only granted on the annual service charge (the fixed charge) – for 2009 the annual service charge was €185.00. No waiver is applied to lift charges.
Local authority 5	Customers receive 26 bin tags per annum (there is no annual service charge). Customers with larger families or who have particular medical circumstances may receive more than the standard 26 tags on a case-by-case basis.
Local authority 6	Each waiver customer receives 8 recycling bin tags and 8 residual waste tags (value €120). From an analysis of waste collection service the local authority estimates that the average household's spend on waste collection is €204. Therefore, the waiver represents 59% of costs.
Local authority 7	For 2009 the waiver covered the standing charge element of the waste collection charge, i.e. €150.
Local authority 8	Council charges are based on an annual collection (standing) charge plus a weight charge related to the weight of waste presented. The waiver scheme currently allows for a minimum waiving of 72% of the collection charge. Depending on the category of waiver customer the waiver can extend to full waiving of the collection charge together with an element of waiver towards the weight charges up to a maximum generally of the equivalent acceptance of 60kg free per annum.
Local authority 9	Weekly income and waiver granted. Single person household: €220–€235 – 50% waiver. €235–€250 – 25% waiver. Other households: €360–€385 – 50% waiver. €385–€410 – 25% waiver.
Local authority 10	The local authority offers a €40 reduction on annual bin collection charge.

All the local authorities felt that the waiver scheme was a major factor in any extra charges they had to apply to fee-paying customers, the increases in their standing charges and a greater difficulty in competing with private collector competitors. Other costs that are incurred by local authorities are fly-tipping and litter collection. These, in effect, are being funded from the charges being applied, according to the local authorities.

Local authorities stated that the numbers of customers availing of waivers was growing and this, combined with a reduction in paying customers, could lead to considerable financial difficulties in the continued provision of service. Two local authorities stated that it might be only a question of time before almost all their customers had waivers with almost negligible income being received to pay for the services provided.

The criteria for acceptance on to waiver schemes commonly involves dependence upon the social

welfare system or low-income level (see [Table 4.2.7](#)). The spread of methods and types of waiver calculation is exceptional and consideration should be given to standardising the system nationally, for public and private collectors, in accordance with the type of waste, the value, and the amount. Given the job losses currently prevalent in Ireland and the economic difficulties of families, the numbers and effects of waivers will increase on local authorities over the coming years and may impact further on their ability to provide waste collection services, let alone compete with private contractors. The issue of waivers was also addressed in the *Draft Statement of Waste Policy* (DoEHLG, 2010). This consultation policy document recommends the adoption of a competitive tendering system for waste collection, with all collectors, both public and private required to offer a waiver scheme to customers. If this policy is adopted, local authorities may not have to bear the main financial burden of waiver customers in the future.



Table 4.2.7. Waiver scheme criteria, 2009/2010.

Local authority	Waiver scheme criteria
Local authority 1	<p>Households whose sole income is derived from any of the following sources will receive waiver of charges as follows:</p> <p>Full waiver: Where total household income does not exceed €317.80 after deduction of €19.30 for each dependent child:</p> <p>Social Welfare Old Age Pension.</p> <p>Unemployment Benefit/Assistance.</p> <p>Supplementary Welfare Allowance.</p> <p>Carers Allowance.</p> <p>Widows Pension.</p> <p>Deserted Wives Allowance.</p> <p>Lone Parents/ Prisoners Allowance.</p> <p>Disability Benefit.</p> <p>Invalidity Pension.</p> <p>Blind Persons Pension.</p> <p>Injury Benefit.</p> <p>Unemployment Ability Supplement.</p> <p>Survivors Benefit.</p> <p>Disabled Persons Maintenance Allowance.</p> <p>Community Employment Scheme and FAS Allowances.</p> <p>Households whose main source of income is from any of the sources listed above but who are in receipt of supplementary income from other sources are entitled to a full waiver subject to the income limits specified above provided that the supplementary income does not exceed €64.00 per week per household.</p>
Local authority 2	<p>The waiver scheme is to assist more vulnerable members of society with the fixed charge for waste collection whose only form of household income is comprised of the social welfare payments listed below:</p> <p>Disability Allowance.</p> <p>Job Seekers Allowance.</p> <p>Old age pension and in receipt of a living alone allowance.</p> <p>Widow(er) Pension and in receipt of a living alone allowance.</p> <p>Supplementary Welfare Payment from the Health Board.</p> <p>Carers Allowance.</p> <p>Blind Persons Pension.</p> <p>Pre-Retirement Allowance.</p>
Local authority 3	<p>OAPs [old age pensioners] and persons whose sole income is by means of social welfare are considered for the waiver scheme on foot of completing an application form (detailing income related info) duly stamped by Post Office or Social Welfare Payments Officer.</p> <p>Upon verification of details by Council Revenue Collectors, applicants are then accepted on to the scheme. Applicants are required to re-apply annually.</p> <p>Customers who do not typically meet the qualifying criteria but who nonetheless incur hardship as a consequence of the charges (e.g. households with a medical condition resulting in increased waste due to incontinence etc.) are treated on a case-by-case basis.</p>
Local authority 4	<p>Applications are considered from households where:</p> <p>The <b>total</b> household income is dependent on a Social Welfare Allowance or Pension.</p> <p>The <b>total</b> household income is exempt from income tax.</p>
Local authority 5	<p>The waiver is currently granted where:</p> <p>Household income is below the threshold for payment of income tax.</p>
Local authority 6	<p>The waiver is assessed on all household income. The following limits apply for 2009:</p> <p>Persons Living Alone where assessable income does not exceed €240.00 per week.</p> <p>Two or more persons where assessable income does not exceed €440.00 per week.</p> <p>In case of special hardship, not falling within the above income limits, the Council may waive charges as is deemed appropriate having regard to the special circumstances of the case.</p>

Local authority	Waiver scheme criteria
Local authority 7	The waiver scheme is open to low income households. Waivers will be granted to: Single person households with an income less than €204.30 per week. Two adult households with an income less than €339.90 per week. For each dependent child add €26 to income limits.
Local authority 8	Waivers will be granted on a case-by-case basis but as a general guide: Single person households with an income less than €220.00 per week and other households with an income less than €360.00 per week will in general be granted a full waiver of the fixed charge. Marginal Relief will apply to households whose incomes are marginally greater than at those listed above. Old age pensioners relying solely on Social Welfare with no other household member will be granted a full waiver of both the fixed charge and the charge per use. Particular cases of hardship will be considered where concessions, other than those outlined above, may be granted at the discretion of the Head of Finance.
Local authority 9	The waiver scheme is based on total income to household – irrespective of what source. The scheme is divided into the following waivers Waiver 1 = total waiver of the full service charge: no payment due. Waiver 2 = reduction of €120.00 on service charge – amount due €65.00. Waiver 3 = reduction of €70.00 on service charge – amount due €115.00. Waiver 4 = reduction of €20.00 on service charge – amount due €165.00. Customer must fill out a Waiver Application Form which must detail all members of the household and the total income received into the household. This income is then to be certified either by the Department of Social Welfare and/or the customers' employers.
Local authority 10	Details not received.

One local authority stated that ‘there is an absolute urgent need in this country for a national waiver scheme operated by the Department of Social Welfare’. Currently, according to another local authority, the Department of Social Welfare advises newly unemployed households to leave their private waste collection service and join the local authority service in order to attain a waiver from charges. This local authority stated that local authorities are retaining services that are not competitive owing to the number of waiver customers, while the private collectors attract fee-paying customers and the local authorities are left with all waiver customers. This is allegedly preventing local authorities and private collectors from competing on a level playing field. One local authority was concerned about the inequity of the situation from the perspective of householders also, whereby households in areas of the country not served by a local authority collection service have no option of attaining a waiver currently. This local authority felt that there should be a national scheme introduced and then, regardless of where in the country the household is located or who provides their collection service (private or public) if they are below a certain income, they should be able to avail of a waiver.

Waivers could influence the amounts of waste being presented per-household, with, for example family members or neighbours availing of free collection and therefore cancelling their subscription with the collector and instead putting their waste in the neighbour/family member's bin for collection without charge. Certainly, it could impede the possibility of gathering accurate per-household waste data and their causes. One local authority actually factors in this waste ‘migration’ in its internal per-household data.

The percentage of customers with a waiver was analysed alongside local authority per-household waste data to examine whether the presence of a large number of waiver customers had an impact upon these figures. The data revealed that the number of waiver customers in a local authority does not appear to impact upon the total amount of waste presented per-household nor increase the percentage of total waste placed in the residual waste bin. Even local authorities with over 30% of their customers on a waiver did not show higher levels of total waste per household or higher percentages placed in the residual waste bin.

#### 4.2.3.3 *Future security*

Waste policy uncertainty is a concern for all waste collectors. Local authorities are unsure whether their role as waste collectors will be able to continue and are awaiting a policy statement on this topic. Until the uncertainty is resolved, most local authority waste collectors are unwilling to invest in changes to the waste management system. In addition to concerns over whether they will be allowed to continue collecting waste, local authorities face increasing competition from private waste collectors, further increasing local authority uncertainty as to their future role in waste collection. Many local authorities were pessimistic about their future, with only the larger authorities showing any optimism and making plans for improvements to their services. On the other hand, the large private collectors appear more optimistic, but they too are seeking clarity regarding future waste policies before investing. The *Draft Statement of Waste Policy* (DoEHLG, 2010) may have alleviated some of these concerns.

#### 4.2.3.4 *Value Added Tax*

Another issue that arose during discussions with local authorities was the issue of the introduction of Value Added Tax (VAT) on waste collection. In 2009 the European Court of Justice ruled that VAT should be required on a selection of local authority services, including waste collection services. This move was taken to remove any competitive advantage to local authorities, as private collectors were already required to charge VAT on their services. Several local authority collectors cited VAT as an additional problem, stating that it would hinder their ability to compete with private collectors by requiring local authorities to raise the waste collection prices issued to customers. Other local authorities were not concerned with the VAT requirement, saying that they in turn could deduct VAT on their inputs, and in that way they would not be required to increase waste charges.

#### 4.2.3.5 *Ability to change service rapidly*

Local authorities stated that one reason they were unable in many instances to compete with private collectors is an inability to change their collection service rapidly. Private collectors can change aspects of their service without difficulty – for example, their collection routes – allowing them to increase the efficiency of the

service. Local authorities are unable to make such rapid or frequent changes, for a variety of legal and industrial-relation related reasons.

#### 4.2.3.6 *Introduction of an organic waste bin*

All collectors discussed the introduction of an organic waste bin. Several of the collectors (especially local authorities) had already implemented this but the majority of collectors had not. The main concerns collectors had with the organic waste bin were the cost of implementation and the contamination levels in this bin.

#### 4.2.3.7 *People not going to private contractors, but opting out altogether*

A local authority that is currently withdrawing from the waste collection market has found that increasing numbers of households are opting out of a waste collection service altogether. The private collectors that operate in the area use annual charges of €400 or more per annum and households are finding that going to the CAS and disposing of their MSW and DRF directly offers a more cost-effective alternative. In this local authority 30% of its households are currently without a doorside waste collection service, and every year the amount of MSW and DRF taken to CAS in the area increases.

### 4.2.4 *An Optimal System from the Perspective of Waste Collectors*

Several key components for an optimised system were identified following discussions with waste collectors. The components are those that collectors feel would improve the running of their systems from an operator perspective. These components are:

- Pre-service billing;
- A reliable automated system;
- Data collection on customers.

#### 4.2.4.1 *Pre-service billing*

The method of billing households for their waste service was a primary concern for many collectors. Post-service billing involves billing households for their waste collection service following the collection of their waste, for example, by sending a bill to a customer in April for the waste collected from January to March. Many waste collectors have reported difficulties in receiving payment from some customers. The extent

of this problem varies from collector to collector and is a particular issue for local authorities. Collectors using a post-service billing method may find themselves with large sums of money owed by unpaid waste charges, cases of which have been widely publicised. Without money coming in from customers, the waste collection service will eventually become unviable financially owing to lost revenue. In addition, sending out bills, reminders and chasing up unpaid bills all add to the day-to-day administrative load of a system. In a response to these issues, implementing an advance payment system was cited as a key element of any ideal PBU system. In this respect, a tag-a-bin or tag-a-bag system is at an advantage, with households buying the tag, bag or sticker in advance of their waste being collected. However, advance payment can be applied to all forms of PBU using a top-up system. This functions in a similar manner to a 'pay as you go' mobile phone. Each customer has an account that they can credit, they can place money or 'top up' their account via the internet, telephone, in shops, or in the post office. The account has to be in credit in order for their waste to be collected. This method is becoming more popular; several collectors have already adopted this system and many more collectors are currently keen to do so.

#### *4.2.4.2 A reliable automated system*

An optimised PBU system should be a reliable automated one. The systems that were repeatedly criticised by waste collectors (tag-a-bin and tag-a-bag) were done so for the most part on the basis that they are 'manual' and are as a result more labour intensive. A tag or bag system involves a staff member driving around distributing tags to shops, the manual counting of tags (to be sent out to shops and collected from lifted bins), tag-collection issues, the possible stealing of tags, possible fraud, and so on. In contrast, weight and lift systems involve a high level of automation. These systems do not require large amounts of time from administrative staff, and are considered easy to manage. Although expensive to set up, collectors indicated that this system is no more expensive to run than a tag-based system, and in some cases may be cheaper, with one collector commenting that the set-up costs of the system will be paid within three years. Under an automated system each bin is chipped and linked to a customer, data is gathered for each bin on the back of the waste truck and is transferred in real time to the office, data on customers

is added into the software system automatically without staff input and automated invoices are produced. This results in reduced administrative overheads, reduced risk of fraud, easier collection and ensures a streamlined, easy-to-manage system.

#### *4.2.4.3 Data collection on customers*

Data collection makes planning easier. For this reason, data collection is considered central to an optimised system. An optimised system should gather information on customers that will enable collectors to plan collection more effectively. Information on customer use of the service allows collectors to alter routes to increase efficiency. By reducing driving distance, collectors can reduce the costs of running the service. Weight-based PBU systems gather the greatest amount of information on customers, followed by lift-based PBU systems. Tag-based (and most differential bin) systems do not gather information, and in the cases where an annual service charge is not used in conjunction with the tag charge, collectors do not always know who their customers are, or how many they have.

#### *4.2.3.4 Linking the components of an optimised system to PBU systems*

Most of the components of an optimised system are not dependent upon the PBU charging system itself but instead upon specific elements that can be applied to several different PBU systems. However, the criteria of automation and data-gathering effectively eliminate tag-a-bin and tag-a-bag systems for consideration as optimised PBU systems. This is reflected in the fact that many collectors currently operating tag-a-bin are keen to move away from this system. The remaining PBU systems (weight, lift and differential bin size [where the bins are chipped and the data is collected]) can all apply the listed components of an optimised system from the perspective of waste collectors.

All of the large private waste collectors use automated systems that allow them to gather information on customer use. The majority of local authorities are also moving towards automated systems.

Collectors using tag-a-bin are moving to pay-per-lift systems, frequently with longer-term plans to move to a weight-based system. When asked for opinions on moving to a weight-based system, most collectors were not averse to adopting this system. Collectors pointed out that they had the automated systems in

place already and would have only to add the weighing component to the back of the waste collection trucks. This would not be a major cost in comparison to the cost of moving from a manual system across to an automated system. Collectors also pointed out that it may be the best option for them in the longer term as collectors are charged at landfill based on weight. Weight-based systems would allow more accurate pricing from the waste collectors' perspective, since under non-weight-based systems (such as tag or lift) the cost charged to householders does not correspond to the cost charged to collectors at landfill. This allows the possibility of households presenting a greater weight of waste than they pay for in the tag or lift price. Under a weight-based system the charge issued to householders per kilogramme could more accurately reflect the charge issued to waste collectors per tonne. Collectors felt that, particularly with potential future increases in the landfill levy, weight-based systems could be at an advantage over other PBU systems. However, other collectors had reservations about weight-based systems, feeling that contamination levels would be too high.

Pay-per-lift, when used with an advance payment card, was frequently considered the next step on from tag-a-bin by tag-based collectors. This system would move collectors away from a manual system and would gather data on customers. Several collectors are purchasing weighing technology for collection trucks, while applying a per-lift charge to households. This will allow these collectors to plan effectively and inform them as to the value or not of moving to a weight-based system in the longer term, while still allowing households a familiar unit of payment, per bin. In this way pay-per-lift can be considered an optimal first step into automated data-gathering systems.

Differential bin size households pay for their waste collection service in advance, a key component of an optimised system from the perspective of waste collectors. The same technology used in weight-based systems or lift systems can be used for differential bin size systems, and many larger collectors using several PBU systems have these facilities in place on trucks running on differential bin size routes. These components are not necessary for this system but can be used alongside it to gather data. In doing so this system would become more costly to establish and run,

removing several of the main reasons why collectors chose to use this system in the first place.

Collectors currently using manual systems and post-service billing stated that they would welcome information on moving towards automated advance payment systems. The following pages briefly outline issues encountered by collectors that have adopted these system components.

#### *4.2.3.5 Moving to an automated system with data collection: Problems encountered*

Three key issues must be dealt with when moving to an automated system:

- Chipping bins;
- Compatibility of new system software with existing software;
- Staff education.

When moving from a manual system (such as tag-a-bin) to an automated system (such as pay-per-lift), existing bins will need a microchip inserted. Chipping existing bins has been surprisingly problematic for collectors. Problems encountered in this process include: locating all bins within the planned timeframe; problems with chip-reading, and bins receiving more than one microchip, resulting in problems with chip-reading.

Automated waste collection systems require specific software onto which data gathered on the collection route is stored. This software is sold alongside the weighing/lifting technology required on each truck. Problems have occurred in cases where collectors have continued to use existing in-house software alongside the new system. In doing this, collectors (in particular, local authorities) have found that moving to an automated system did not reduce their workload. Ensuring compatibility with existing software and, where required, changing all relevant software so that they work together as a single system is vital to the smooth running of an automated system.

Staff education when adopting a new system is vital – crew training necessary. For example, collectors have had issues with crew forgetting to watch the in-cab screens when bins are being lifted, as they would not have been required to do this under the manual systems used previously.

*4.2.4.6 Moving to an advance payment system:  
Problems encountered*

One problem reported by collectors when moving to an advance payment system was that of public education. Collectors have found that, when introducing a new payment system, spending time on public education can reduce initial problems and ultimately save money. One collector that introduced a top-up card system reported that when householders were sent out the cards in advance of the system being implemented, many households disposed of the cards before they needed them. When the system began, the phone lines were flooded with calls from customers requesting a new top-up card. This involved a large degree of administration and extra cost. Further time spent on public education, and better communication might have reduced the need to send out so many second cards.

**4.2.5 Summary and Conclusions**

Waste collectors using a weight-based PBU system felt that its main advantage, apart from the reduction in residual waste, was the data-gathering the system allows. The system gathers accurate data on weights and frequency of presentation, which enables waste collectors to plan their collection more efficiently. In addition, weight-based charges do not encourage waste compaction, which may be a problem for other PBU charges. The main disadvantage of weight-based charges is the expense involved in setting up the system, though several collectors stated that the system is not expensive to run following the initial set-up costs.

Another significant problem has been the use of post-service billing, which can lead to arrears and the use of resources to pursue these. This problem can be overcome by the use of an advanced payment system. Furthermore, households with weight-based charges present their bin frequently, even when not full, pushing up waste collection costs for collectors. The use of a lift charge alongside the weight charge can remove this problem.

Three forms of tag charges are grouped within the tag-based charge category – each with different advantages and disadvantages for the waste collector. A lift charge requires a large set-up cost, as the system uses chipped bins, trucks with chip-reading technology and associated software. In addition, this system involves post-service billing, which may lead to administrative

costs in following up unpaid bills. This problem can be overcome by introducing an advance payment credit system, as many collectors are currently selecting to do. Tag-a-bin and tag-a-bag charges do not involve large set-up costs, but ongoing costs of buying tags and bags, distributing these to shops, as well as administration costs are incurred. The low cost and the upfront payment by households are the main advantages of these tag-based charges from the perspective of waste collectors. Despite these advantages, the majority of collectors contacted expressed the opinion that tag-a-bin and tag-a-bag systems are cumbersome and have a large administrative burden. In addition, these two systems do not allow for detailed data-gathering by waste collectors, except when bin chips are used. Tag-a-bag has the further difficulty of broken bags leading to vermin, and this system is rarely used. Most large collectors that are currently operating a tag-a-bin or tag-a-bag system are now moving away from them, towards more automated systems. A further problem with tag-a-bin and tag-a-bag has been that several collectors have operated these systems without using an annual flat charge alongside the use charge. This approach prevents waste collectors from having a stable income and has not been successful, with some collectors closing their waste collection operations owing to financial difficulties.

Waste collectors using a differential bin size charge stated that the main advantage of this system is that it is easy and cheap to introduce and administer. The system involves an annual charge, paid at the beginning of the year. This charge is paid in advance of the service being provided, ensuring a stable income for waste collectors. The fee can be paid in a lump sum, requiring the collector to send out only one bill to each household, reducing administration costs. However, the majority of collectors now offer households the option of paying monthly or quarterly (using direct debit schemes) to ease the financial burden. From the perspective of waste collectors this system appears attractive. Nevertheless, if the system results in large amounts of residual waste being presented by householders, the waste collector will incur the cost of disposing of this at landfill.

It is also clear that the current waiver system, as it is being implemented at present, is a significant burden on local authorities and appears to be a major factor in several local authorities already having withdrawn

from collecting domestic waste altogether. A revision of this scheme is recommended whereby the waiver of domestic waste charges would be available to all those who qualify (whether from public or private collectors) and the system should be standardised. The burden of these waiver costs should also not be borne by the waste collectors alone.

### **4.3 Impact of Pay-by-use Charges on Households**

#### **4.3.1 Introduction**

In order to gather this data on householders' experiences of their PBU charges, three methods were used: (i) a postal survey carried out by the research team, (ii) a telephone survey carried out by the research team, and (iii) a national telephone survey undertaken by Red C Research and Marketing. The key aims of the surveys were:

- To establish the impacts of the PBU systems upon: household-source reduction; household recycling levels; household composting; illegal waste diversion of all types; household bin-sharing; and household selection to opt out of bin collection system.
- To identify householders' opinions on: the advantages and disadvantages of the PBU system they use; the value of PBU as a method of encouraging household source reduction, recycling and composting; the impact of PBU on illegal waste diversion, bin sharing and bin service cancellation.

The PBU systems were examined in terms of both waste management behaviour and ease of use in order to generate an overview of household experiences of each PBU system. Studies into determinants of the success of PBU have found that public acceptance is central to the effective functioning of a system (Cantebury, 1998). On this basis, finding out householder experiences and opinions on PBU systems may result in the development of an improved system, with corresponding improvements in waste diversion and prevention.

Section 4.3.2 describes the situation regarding household collection systems in Ireland, and presents data on the percentage of households with and without a service, whether the service is private or public,

which kind of PBU system is used, data on waivers, etc. Sections 4.3.3 to 4.3.6 outline public acceptance of PBU domestic waste charges in Ireland, and the impact the charges have had on householders' waste management behaviour.

Investigation into public acceptance of PBU was considered relevant for study following the dissent over waste charges that occurred in the Dublin region in 2003 and 2004, and also in other regions, with waste charges referred to as a 'bin tax' and the fears of double taxation raised in the public's mind. In the five years between its introduction in 2006 and 2011 (when this report was published), the public has had time to develop informed opinions on the charges and their impacts upon their waste management. The survey examined householders' opinions of PBU charges, before and after their introduction, to determine levels of public acceptance in comparison with the flat fees (or no fees) applied previously.

The study also examined householders' perceptions of the impact PBU has had upon their waste management behaviour. Information gathered, as part of the study into the impacts of PBU upon the environment, established that PBU charges encourage recycling and source reduction, with weight-based charges prompting this behaviour more than tag-based or differential bin size charges. With this in mind it is interesting to examine householders' own perceptions on how PBU charges have influenced themselves.

Section 4.3.7 outlines some data on those households without a waste collection service.

Section 4.3.8 presents a summary of results and some conclusions.

#### **4.3.2 Household Collection Systems in Ireland**

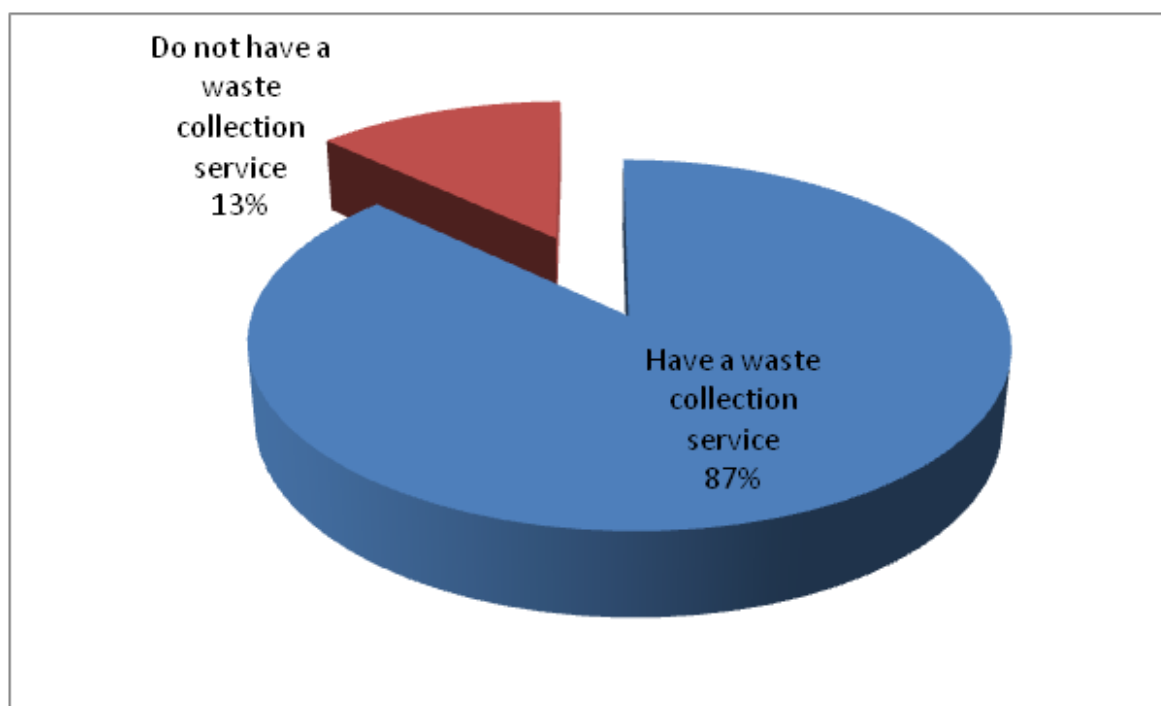
The Red C survey interviewed 1,000 people as part of their omnibus service. The sample was quota controlled and weighted to the known national population data from the Central Statistics Office (CSO) 2006 census. Therefore, those surveyed were representative of the Irish population in terms of geographical location, age, gender and social class.

However, not all of the 1,000 people contacted for the survey were responsible – either fully or partly – for the waste collection costs in their household. Of those

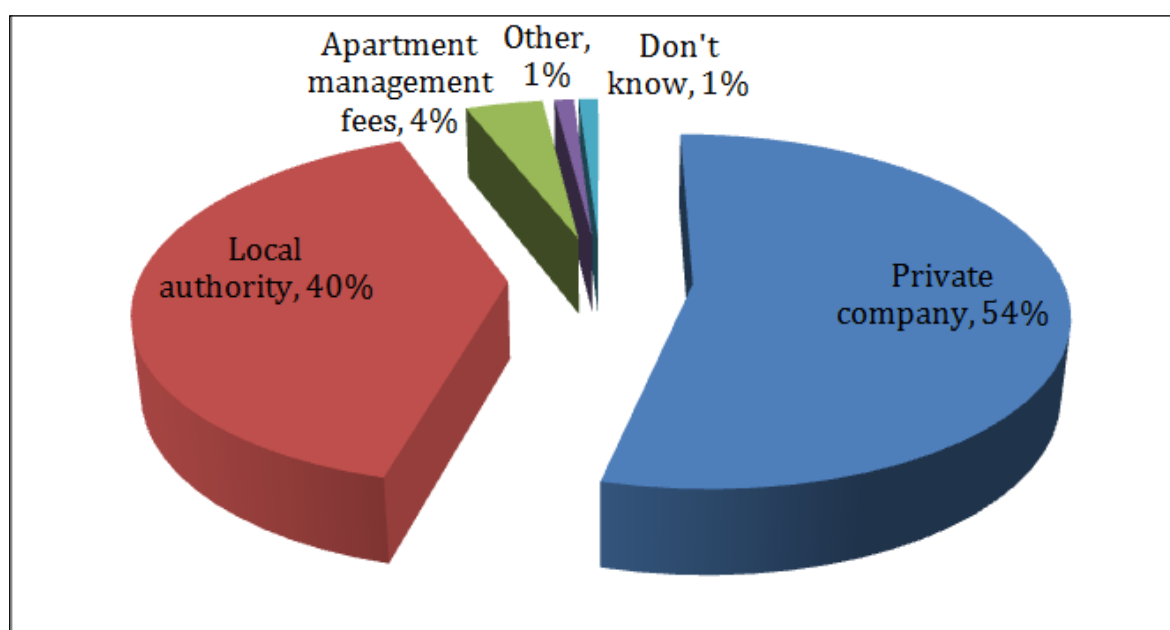
surveyed, 790 were fully or partly responsible for these costs, and they were questioned on the waste collection services, or lack of, for their households.

Of the households surveyed, 87% had a waste collection service and 13% did not ([Fig. 4.3.1](#)).

The respondents with a collection service were asked whether their service is provided by a local authority or a private waste collector. More people were using private companies for their waste-disposal service than local authorities (see [Fig. 4.3.2](#)).



**Figure 4.3.1. Percentage of households surveyed with and without a waste collection service.**



**Figure 4.3.2. Waste collectors used by households.**



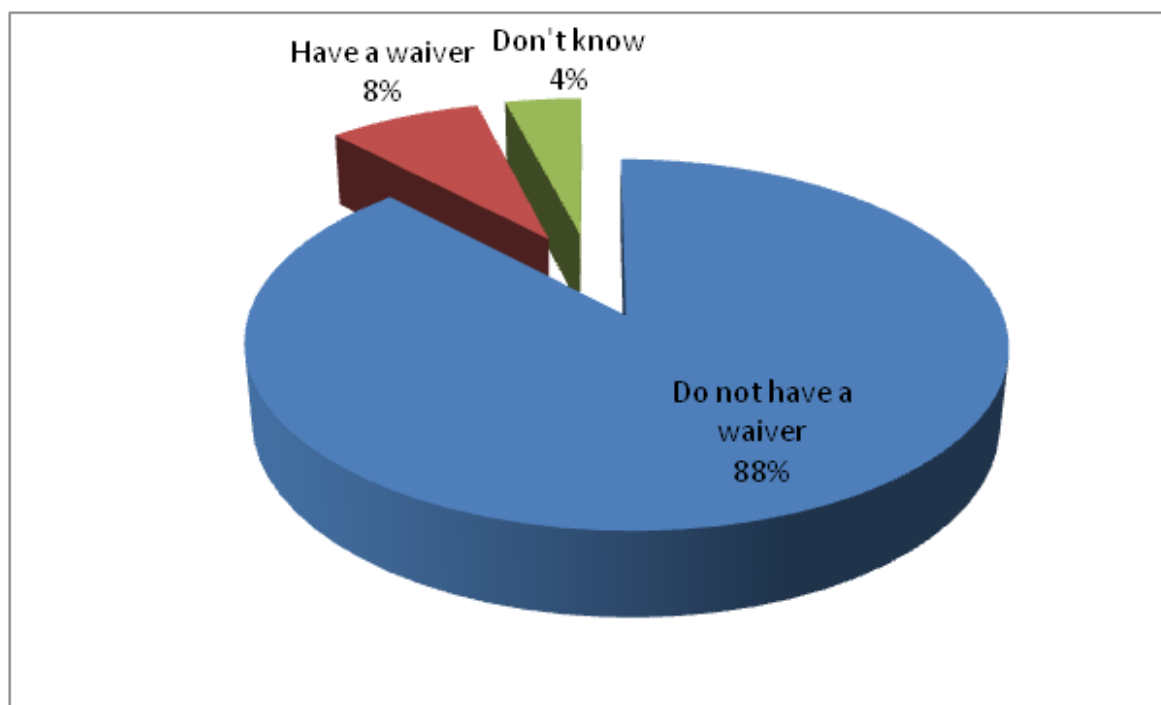


Figure 4.3.3. Percentage of households with a waste charges waiver.

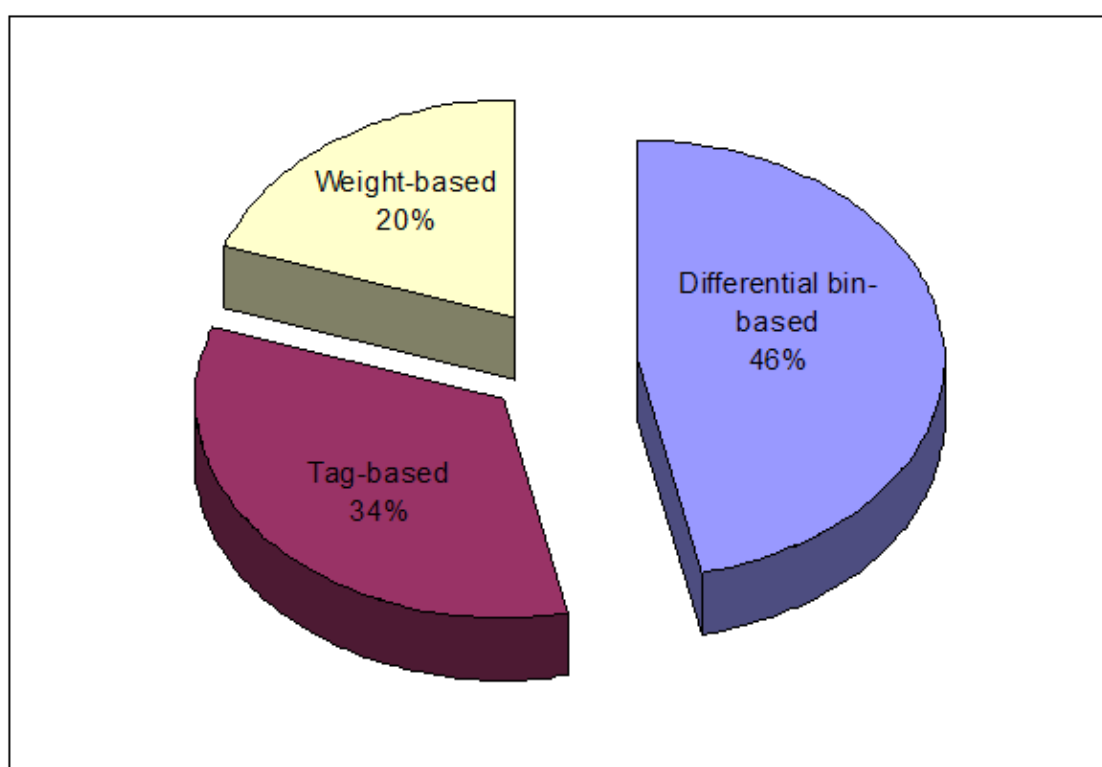


Figure 4.3.4. Pay-by-use systems used by households.

Of respondents asked whether they had a waste charge waiver from their collector, 8% stated that they did have a waiver and 88% responded that they did not. This corresponds to 14% of local authority customers and 5% of private collector customers with a waiver ([Fig. 4.3.3](#)).

Respondents were asked which PBU system they used. Of those respondents who gave this information, 46% said they used differential bin based charges, 34% said they used tag-based charges and 20% said they used weight-based charges ([Fig. 4.3.4](#)).

It was also found that private waste-collectors customers are most likely to use a once-off annual payment method, while local authority users are most likely to use the number of tags/lifts method.

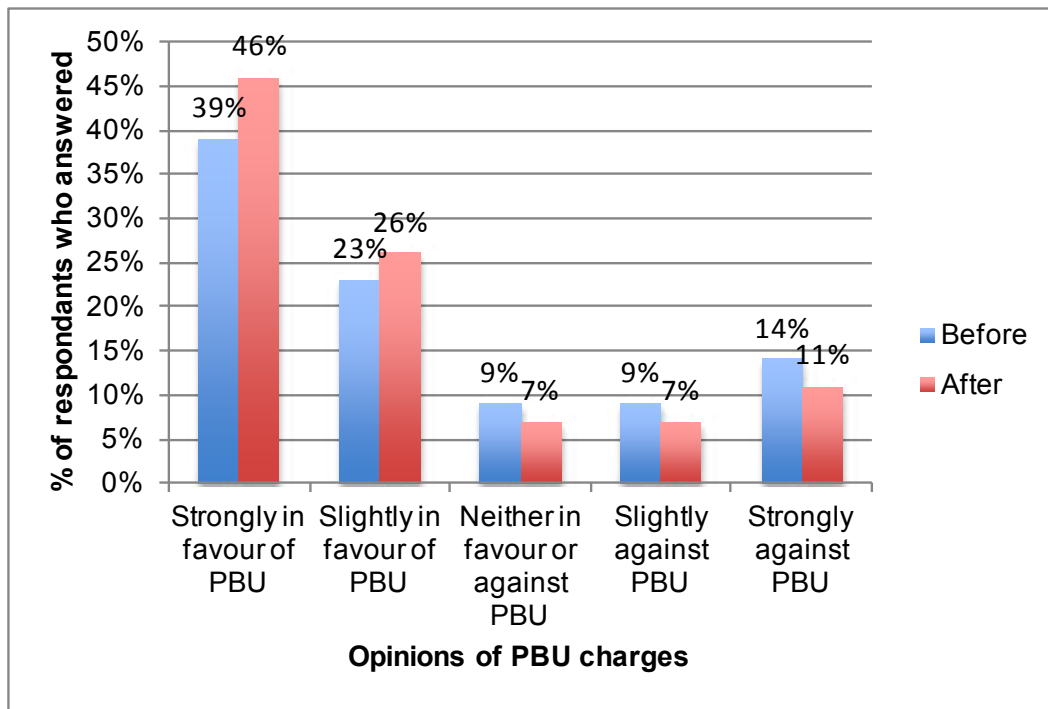
#### **4.3.3 Public Acceptance of Pay-by-use Charges**

Respondents were asked their opinion on PBU charges before they were introduced. They were then asked for their opinion on the charges subsequent to their introduction. The question was designed to examine if use of a PBU system has altered householders' opinion of this form of charging. Prior to the introduction of PBU charges, 62% of respondents were in favour of the charges and 23% were against the charges. Following the introduction of PBU, 72% were in favour and 18% were against (see [Fig. 4.3.5](#)).

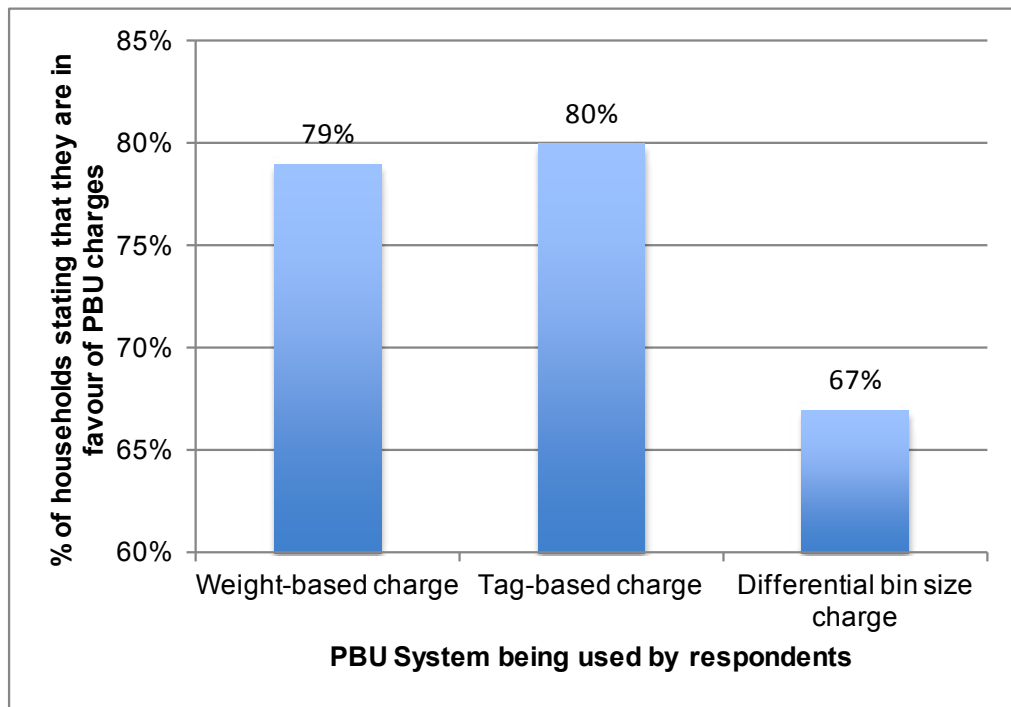
Overall, a decline in the number of people who are against PBU charges from before they were introduced to after they were introduced can be observed. Now that the charges have been introduced, more people

are currently in favour of the charges. This is a positive reflection upon PBU: use of the system may increase its favourability to householders.

These findings were analysed by each type of PBU system to determine whether this influenced respondents' view on the charges. The results indicate that households with a differential bin size charge are less likely to be in favour of PBU charges: only 67% of households with a differential bin size charge stated that they are either slightly or strongly in favour of PBU as opposed to 79% and 80% of weight-based and tag-based households respectively (see [Fig. 4.3.6](#)). Correspondingly, more households with a differential bin size charge stated that they were against PBU charges (18%) than households with a weight-based or tag-based charge (15% in both cases). This finding – that households favour tag-based and weight-based charges over differential bin size charges – is particularly interesting in light of the finding that this PBU system is most commonly used nationally.



**Figure 4.3.5. Opinions on pay-by-use (PBU) charges prior to and subsequent to introduction of PBU charges.**



**Figure 4.3.6. Percentage of households in favour of pay-by-use (PBU) charges relating to the system they have.**

Prior to PBU introduction, those using a local authority collection service were less likely to be in favour of the waste charges than private collector customers (30% to 19%). Following the introduction of PBU, local authority users remain slightly less positive overall than private company users (70% and 74% respectively, see [Fig. 4.3.7](#)). This may be attributed to differences in charging for waste collection prior to use based systems. Private collector customers were sometimes paying for waste on a per-use basis prior to PBU requirements. It was more cost effective for private companies to charge households an annual fee based on the bin size they selected to use. Local authority customers were charged using a flat annual fee and in several cases did not have to pay for waste collection at all. These differences prior to PBU may account for the lower level of acceptance found in local authority customers. In addition, it is possible that a proportion

of local authority customers object to paying for waste *per se* and that this lower level of acceptance may be focused upon waste charges themselves rather than PBU waste charges specifically. Furthermore, households may be more accepting of charges issued by private companies as they are accustomed to paying for other private services (such as electricity, gas, satellite TV, etc.), whereas households may feel that local government should provide services free of charge from the taxes they pay. Dunne *et al.* (2008, p. 7) supported this finding in a recent study of waste charges in Ireland, stating that 'In general there seemed to be less resistance in areas where the charge was privatised, perhaps because it was more palatable to be paying for a private service and a simple consequence of not paying was not getting the service. When the local authority is involved, it has the tendency to be perceived as a more political issue.'

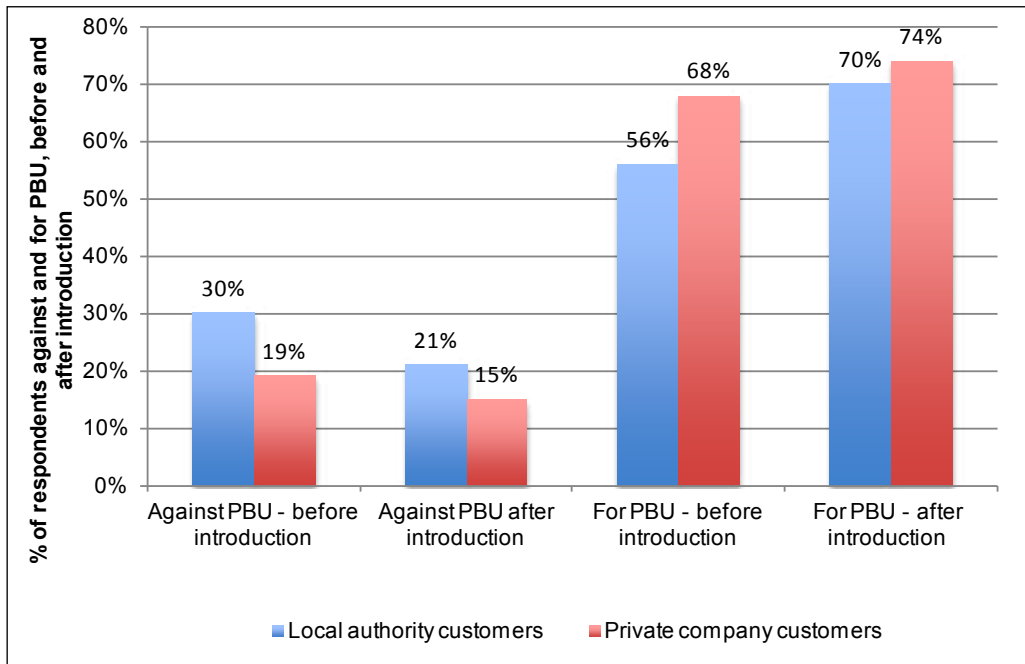


Figure 4.3.7. Comparing the opinions of local authority customers and private waste customers on pay-by-use (PBU) charges.

#### 4.3.4 Waste Charges and their Impact on Household Waste Management Behaviour

Respondents were asked to rank the impact PBU charges have had upon their waste management behaviour on a scale of between 1 and 10, with 1 being 'not at all impactful' and 10 'extremely impactful'.

A concern in analysing the strength of impact is the subjective element involved in deciding what qualifies as a high impact. A rating of high impact could be considered a ranking of 7 and over, or 8 and over. While a cut-off point of 7 results in 46% of households reporting their PBU charges as extremely impactful

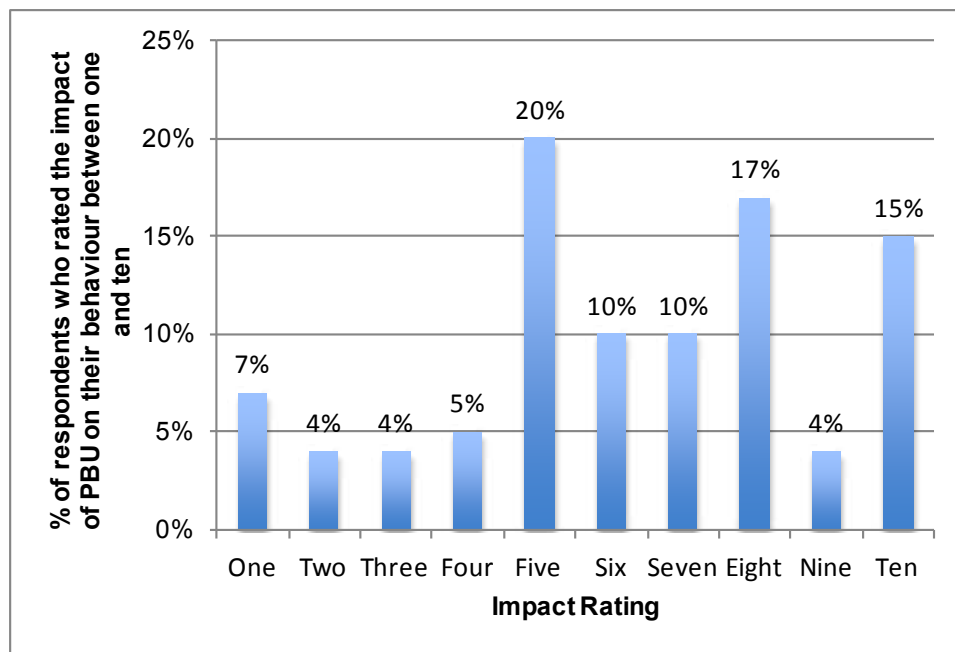


Figure 4.3.8. Impact of pay-by-use (PBU) charges have had on respondents' waste management behaviour.

upon their behaviour, a cut-off of 8 leads to 36% of households feeling this way. But, wherever the cut-off point for high impact is placed, it is clear that only a small minority claim that PBU has had little or no impact upon their waste management behaviour, with only 20% ranking the impact of PBU below 5 (see [Fig. 4.3.8](#)).

The responses were then analysed by PBU systems to determine if these influenced the level of impact felt by households. The greatest impact was felt by weight-based customers, followed by tag-based customers, with differential bin size customers feeling the least impact on behaviour from their PBU charge.

Changing the cut-off point for high impact (say, taking 7 rather than 8 as the cut off for 'high impact') influences the comparative impact on each PBU. Taking rankings of 8 and over as highly impactful, it is found that more weight-based customers find their charge extremely impactful, with 43% of weight-based, 41% of tag-based

and 35% of differential bin size households ranking their charges within this bracket. However, when 7 is taken as the cut-off point there is a larger discrepancy between PBU systems with 65% of weight-based, 50% of tag-based and 42% of differential bin size households ranking their charges within this high impact bracket. In both cases, differential bin charges cause the least impact on behaviour regarding waste management. Irrespective of where the cut-off point is placed, weight-based charges are found to have the most impact upon waste management behaviour, followed by tag-based charges, with differential bin size charges having the least impact. This finding corresponds with the results found when examining the impact of Irish PBU systems on the environment, in addition to the international literature, and economic theory. The breakdown of results for each impact rating within the three PBU systems is detailed in [Figs 4.3.9](#) and [4.3.10](#).

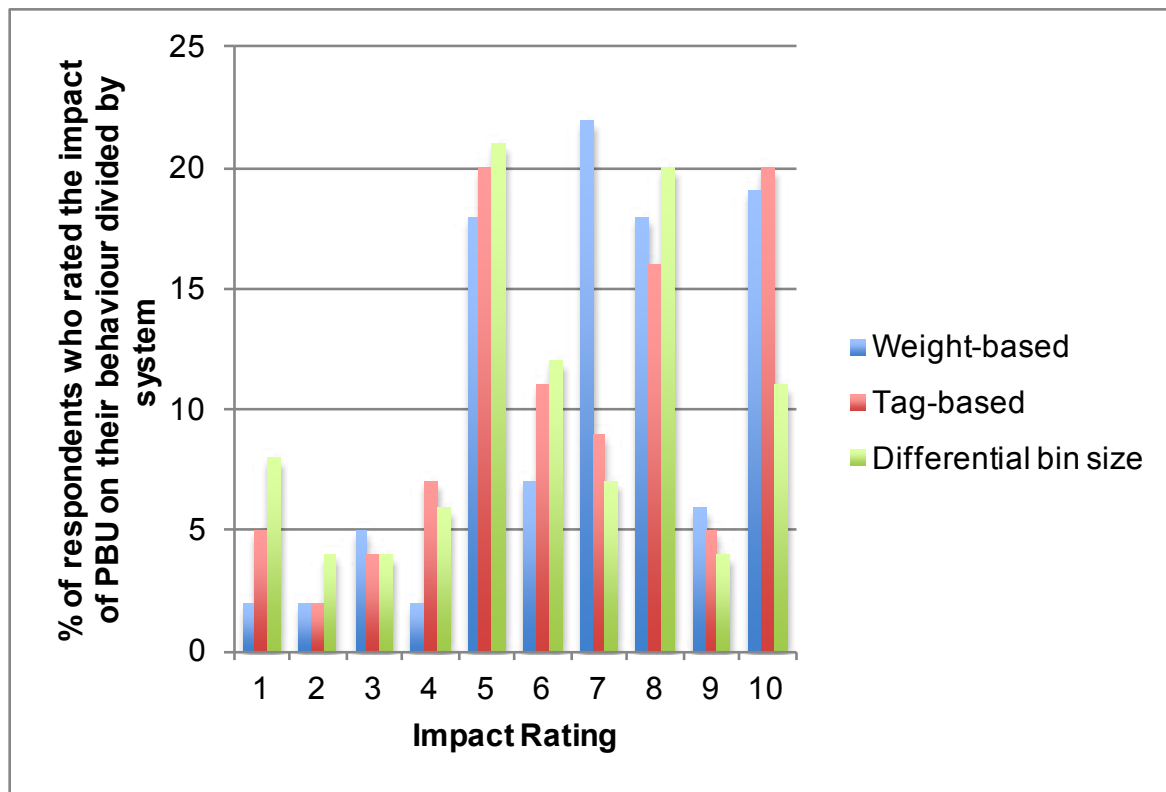


Figure 4.3.9. Impact ranking of pay-by-use systems (PBU).

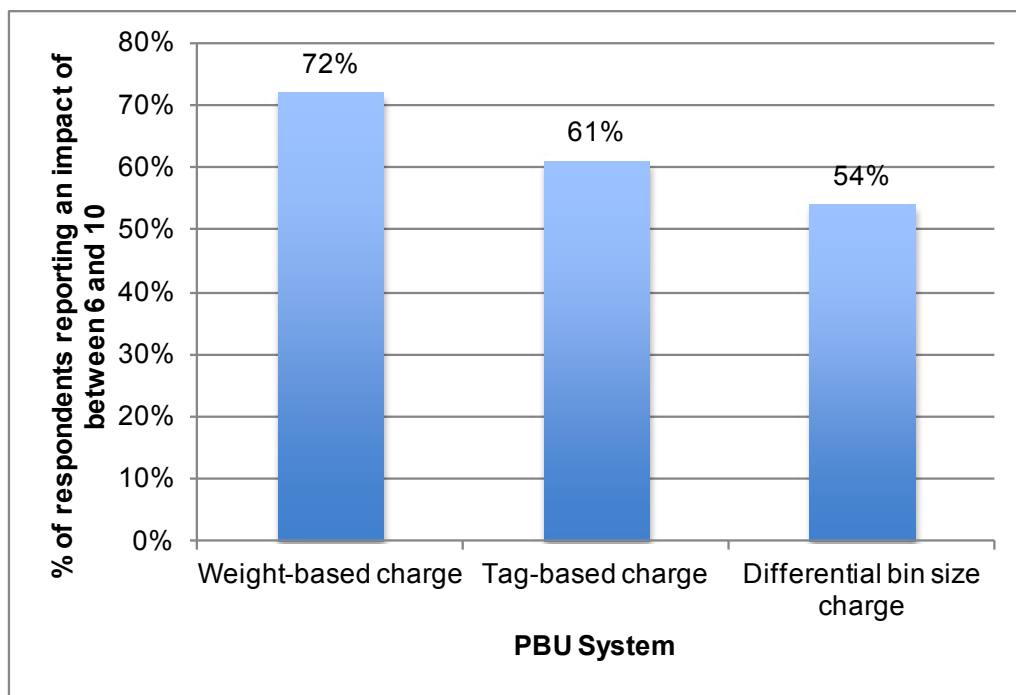


Figure 4.3.10. Impact ranking between 6 and 10 of pay-by-use (PBU) systems.

#### 4.3.5 Attitudes towards Waste Collection Charges

Respondents listened to a number of statements on PBU charges and were asked whether they 'agreed strongly', 'agreed slightly', 'disagreed slightly' or 'disagreed strongly' with the opinions expressed in the statements.

##### 4.3.5.1 PBU and recycling

The majority (83%) agreed strongly with the statement 'PBU charges encourage me to recycle', with only 7% disagreeing with this statement (see [Fig. 4.3.11](#)).

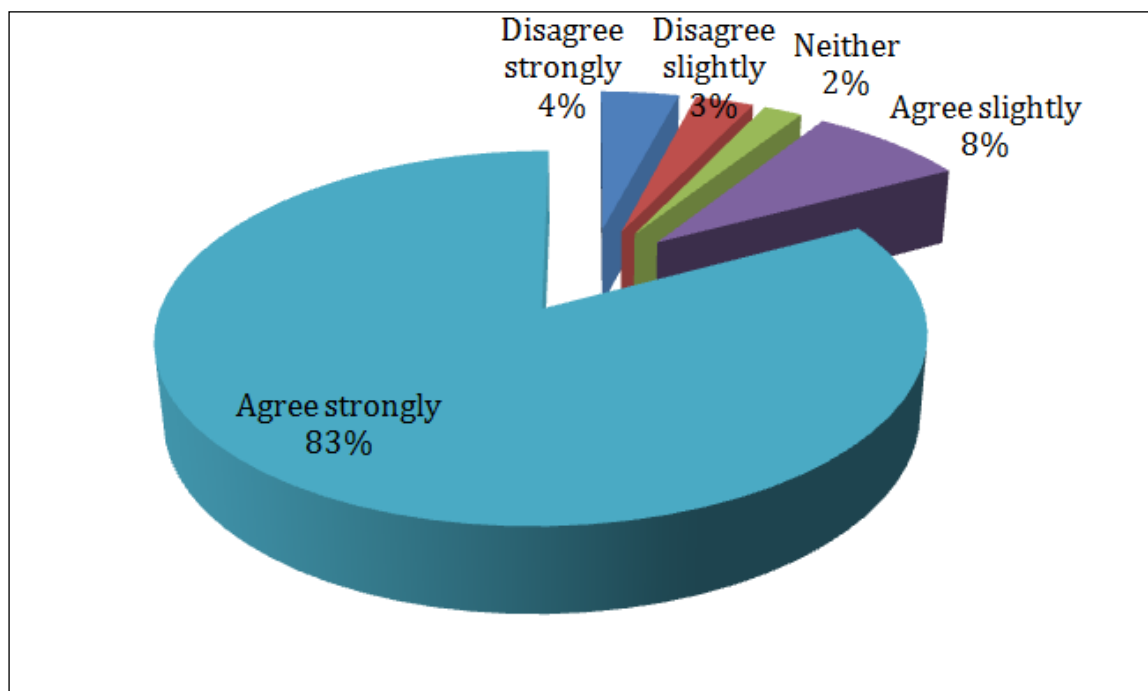
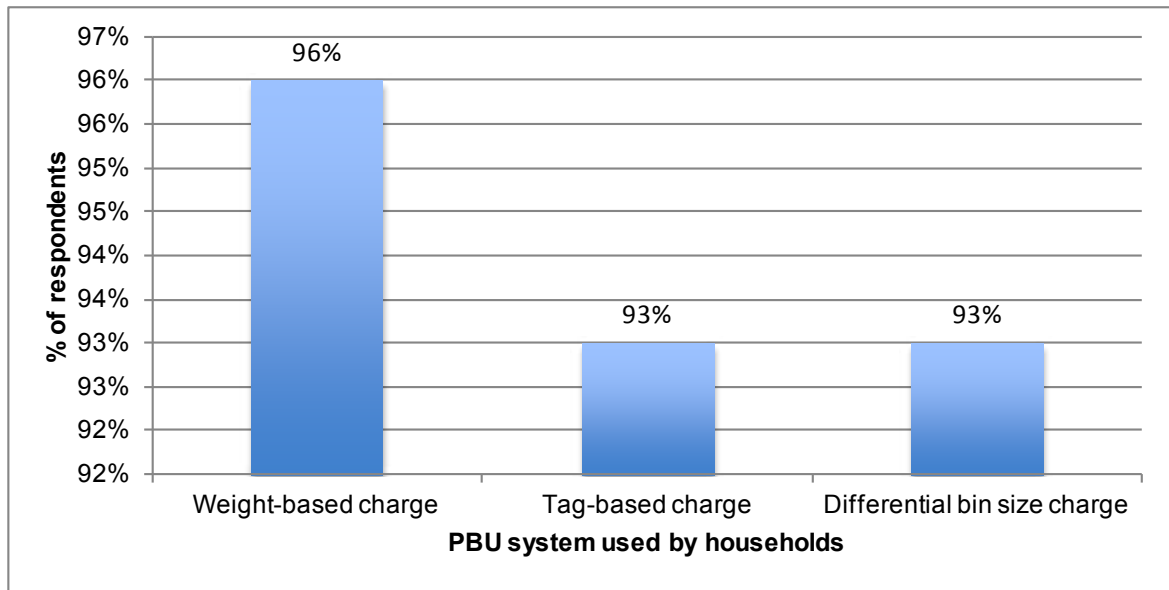


Figure 4.3.11. Percentage of respondents within each pay-by-use (PBU) system agreeing with the statement 'PBU charges encourage me to recycle'.

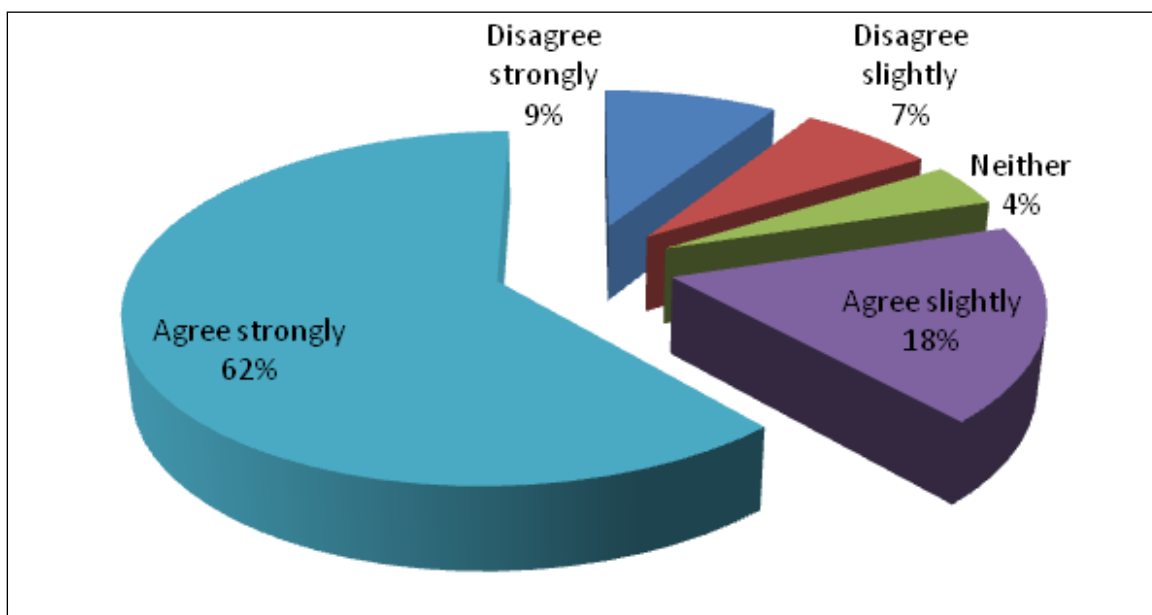


**Figure 4.3.12. Percentage of respondents within each pay-by-use (PBU) system agreeing with the statement 'PBU charges encourage me to recycle'.**

Respondents using a weight-based PBU system were slightly more likely to agree with the statement, with 96% of weight-based respondents agreeing that PBU charges encourage them to recycle, as opposed to 93% of respondents using tag-based and differential bin size systems. This finding reflects the finding of the waste collector study (see [Fig. 4.3.12](#)).

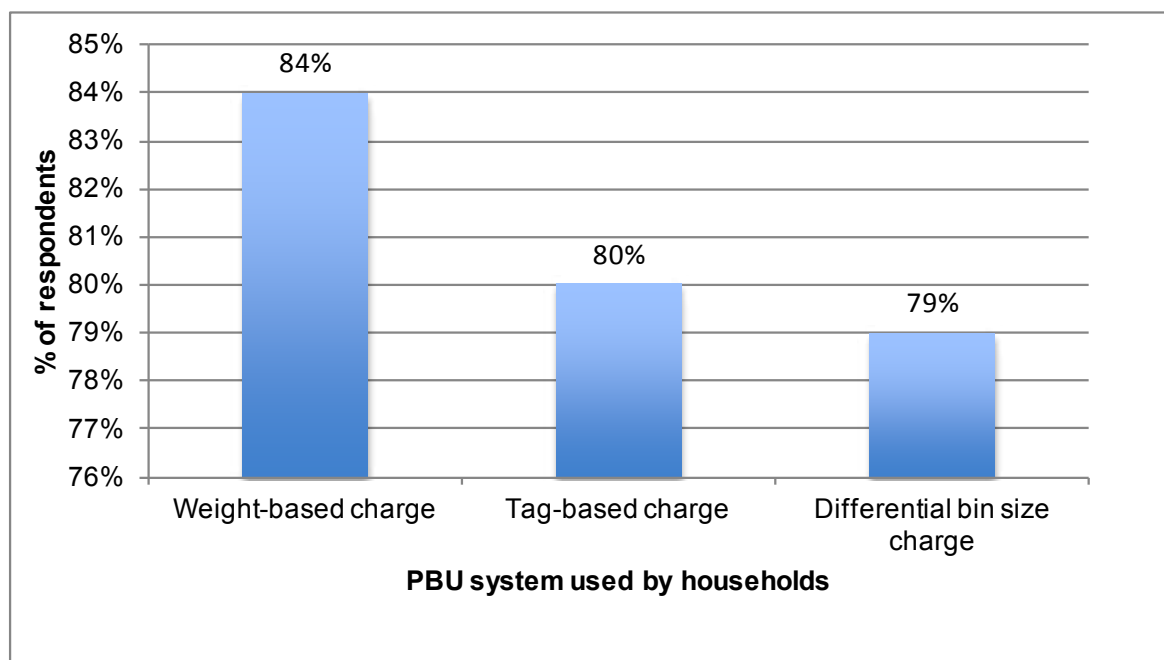
#### 4.3.5.2 PBU and waste prevention

In addition to encouraging recycling, respondents felt that PBU charges encouraged them to reduce their overall waste production, with 62% agreeing strongly and 18% agreeing slightly. 16% felt that the charges do not encourage them to reduce waste (see [Figure 4.3.13](#)).



**Figure 4.3.13. Percentage of respondents within each pay-by-use (PBU) system who agree with the statement 'PBU charges encourage me to reduce my waste production'.**





**Figure 4.3.14. Percentage of respondents within each pay-by-use (PBU) system agreeing with the statement 'PBU charges encourage me to reduce my waste production'.**

Respondents with a weight-based charge were more likely to state that their waste charges prompt them to reduce waste production, with 84% expressing this opinion as opposed to 80% of tag-based households and 79% of differential bin sized households. Again this reflects the findings of the waste collector study.

#### 4.3.5.3 PBU and awareness of waste-disposal costs

Ninety per cent of respondents stated that PBU charges have made them more aware of the cost of waste disposal; 74% agreeing strongly with this statement. Only 7% felt that the charges did not make them more aware of waste costs (see [Fig. 4.3.15](#)).

When examined by PBU system the analysis showed that respondents with a tag-based charge are slightly

more likely to agree that PBU charges make them more aware of the cost of waste disposal (94% of tag-based respondents agreed with this statement) than weight-based respondents (90% agreed) and differential bin size respondents (89% agreed). This finding is unsurprising as households using a tag-based system are required to purchase a tag or bag each time they need to put out their residual waste, and therefore they feel the cost of waste disposal to them on a very regular basis directly. They are sensitised to their waste management behaviour as a result (see [Fig. 4.3.16](#)). This indicates that regular billing (for example, in weight- or tag-based systems) influences behaviour beneficially in comparison with one annual fee.

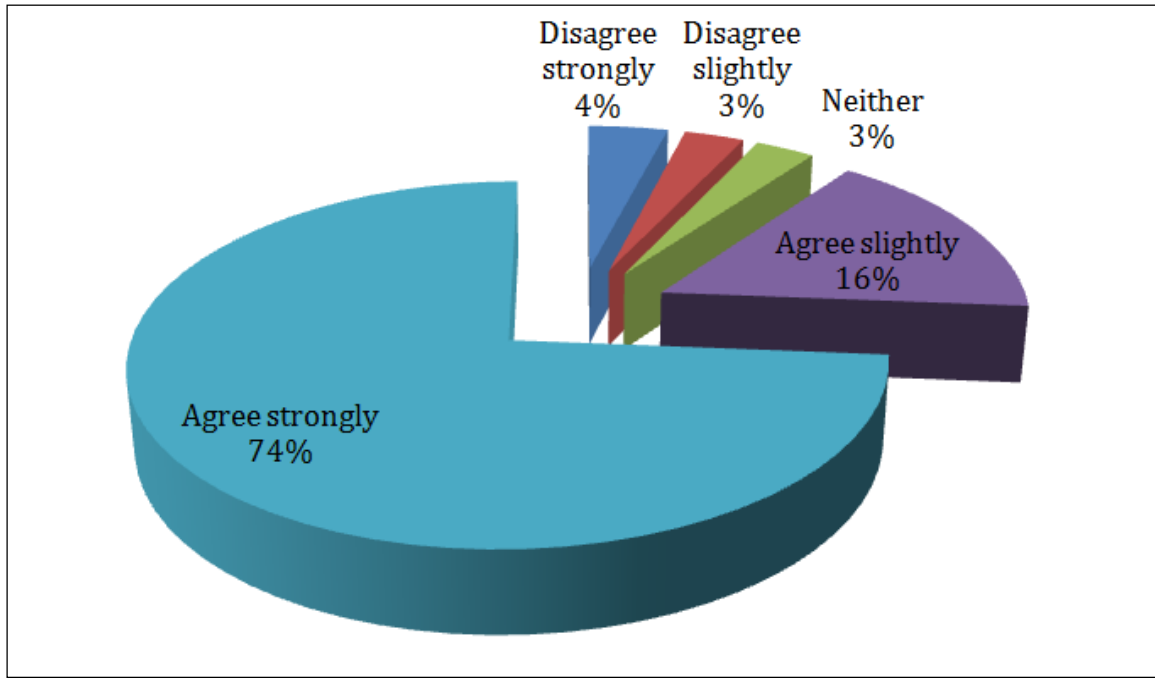


Figure 4.3.15. Percentage of respondents within each pay-by-use (PBU) system agreeing with the statement 'PBU charges make me more aware of the cost of waste disposal'.

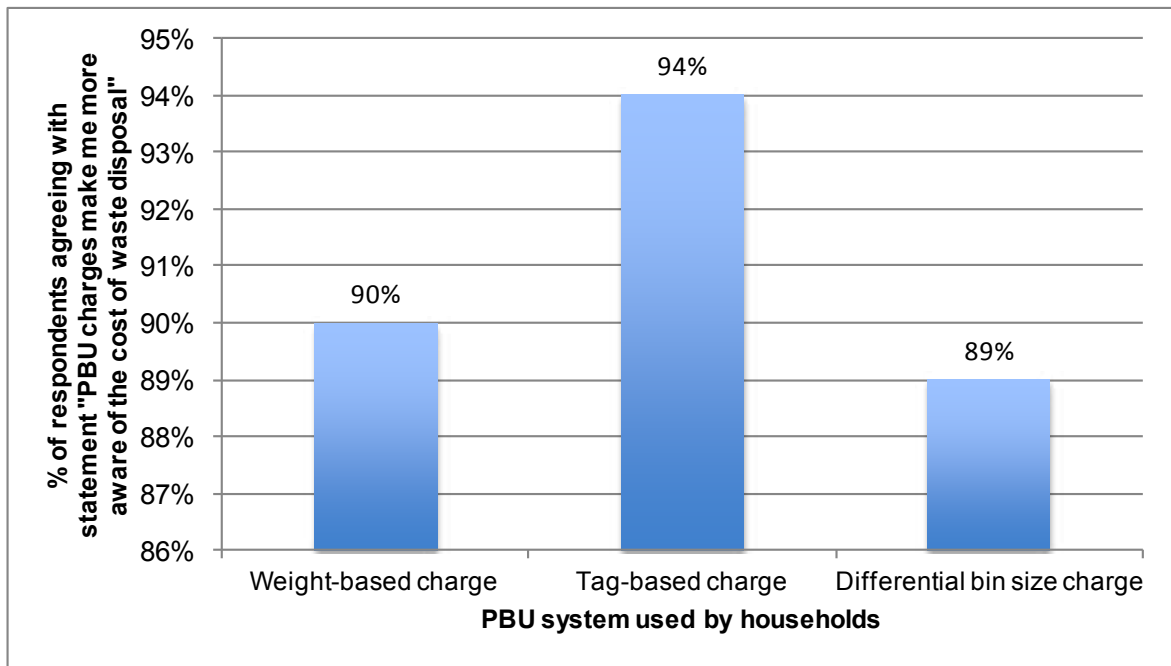
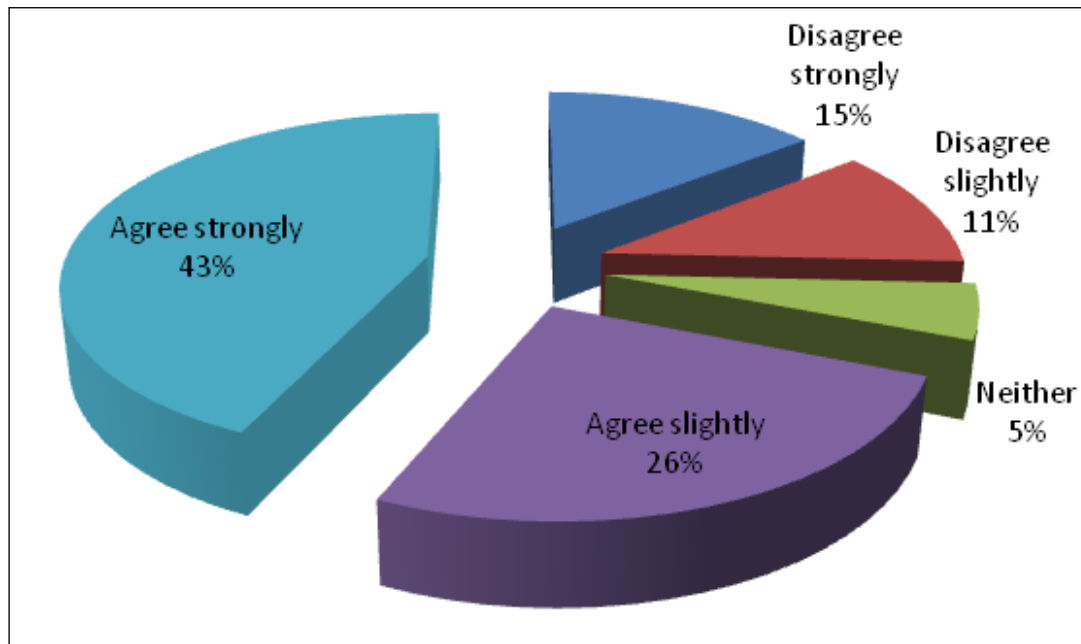


Figure 4.3.16. Percentage of respondents within each pay-by-use PBU system agreeing with the statement 'PBU charges make me more aware of the cost of waste disposal'.



**Figure 4.3.17. Percentage of respondents within each pay-by-use (PBU) system agreeing with the statement 'PBU charges encourage illegal activities such as fly-tipping/burning'.**

#### 4.3.5.4 PBU and illegal waste disposal

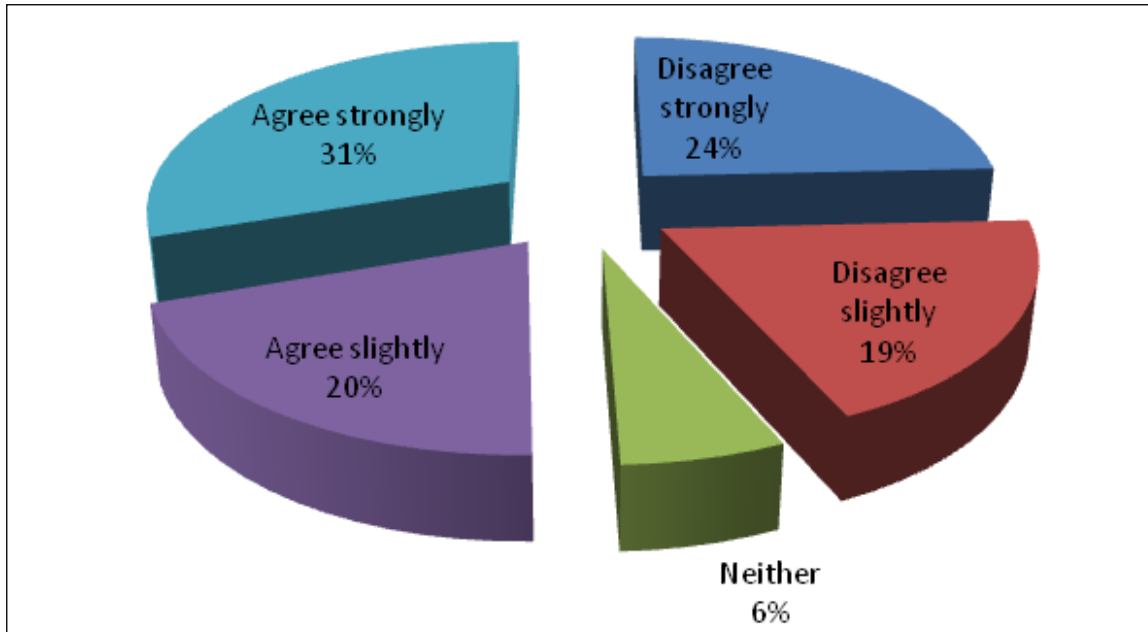
Responses to the question on the role of PBU charges in encouraging illegal waste activities were slightly more divided than for other questions. However, 69% of respondents felt that PBU charges encourage illegal activities such as backyard burning and fly-tipping, with 43% of these believing there is a strong link (see [Fig. 4.3.17](#)). Only households without a waste collection service were directly asked whether they illegally divert waste.

It is difficult to prove or disprove a link between PBU charges and illegal waste activities, with no consensus in the international literature. Inconsistency in the classification and recording of illegal waste activities may account for the lack of data on this topic. In addition, incidents of illegal waste diversion as reported by members of the public may reflect changing levels of environmental awareness and perceptions of environmentally damaging behaviours rather than actual changes in illegal waste activities (O'Callaghan-Platt and Davies, 2008).

Although a large number of respondents (69%) felt there was a link between PBU charges and illegal waste disposal, it is possible that some of these participate in illegal waste activities themselves. A previous study into weight-based PBU charges in West Cork, Ireland found that 40% of households surveyed participated in backyard burning to dispose of waste (Scott and Watson [2006]). In addition, if 69% of people believe that PBU encourages illegal waste activities, households in areas where fly-tipping is common may be less accepting of these waste charges. Non-availability of collection services in a region will obviously influence behaviour also, where it may be inconvenient or difficult to bring waste to landfill, CAS, and so on.

#### 4.3.5.4 PBU and inconvenience

There was a mixed response to the question of whether or not PBU charges increase the burden of waste disposal. The majority of respondents (51%) stated that the charges increase the burden of waste disposal and 43% did not feel they increased the burden (see [Fig. 4.3.18](#)).

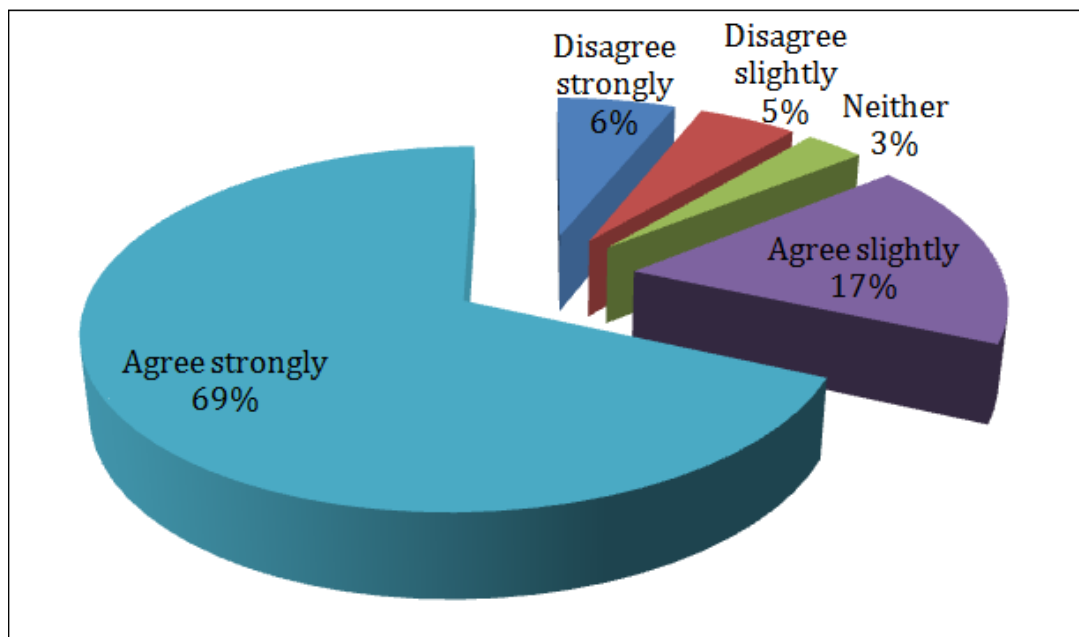


**Figure 4.3.18. Percentage of respondents within each pay-by-use (PBU) system agreeing with the statement 'PBU charges increase the burden of waste disposal'.**

As PBU charges encourage households to recycle, compost and reduce waste, time is required to undertake these activities. Activities such as segregating waste into different materials and visiting CAS or BBs are additional activities households would associate with using a PBU charge.

#### 4.3.5.5 PBU and awareness of environmental issues

Respondents felt that PBU waste charges not only made them more aware of recycling and waste costs but also increased their awareness of wider environmental issues: 69% agreed strongly that PBU charges have had this effect, and only 11% disagreed with the statement 'PBU charges make me more aware of environmental issues' (see [Fig. 4.3.19](#)).



**Figure 4.3.19. Percentage of respondents within each pay-by-use (PBU) system agreeing with the statement 'PBU charges make me more aware of environmental issues'.**

Respondents using a differential bin size system were slightly less likely to agree with the statement, with 84% stating that the charges made them more aware of environmental issues compared with 88% and 89% for tag-based respondents and weight-based respondents respectively.

#### **4.3.6 Comparing Household Impacts of the Various Pay-by-use Systems**

There is a high level of public acceptance of PBU charges in Ireland. Prior to their introduction, 62% of households were already in favour of the charges. This appears a surprisingly high percentage. However, Yamaha (2004, cited in Sakai, 2008) found that at the point PBU charges were being introduced in Japan 59.5% of PBU communities reported public support for the charges, a similar figure to that found in Ireland.

Following the introduction of the charges, this study found that 72% of households are in favour of PBU. Again, this appears to be a high satisfaction level, yet an examination of the international literature on PBU charges reveals a number of studies reporting a positive response to the charges by householders. For example, a study of New York residents found that 78% reported the use of PBU systems as 'fair' or 'somewhat fair' (Stone and Harrison, 1991); a survey of PBU households in Perkasi, Pennsylvania found that 93% of people surveyed approved of the system (Goldberg, 1990); 90% of residents in the PBU areas of Seattle and Ilion (in New York state) were also found to approve of the charges (Morris and Byrd, 1990); and two-thirds of respondents in Tompkins County, New York expressed a preference for PBU waste charges (Reschovsky and Stone, 1994).

Moreover, the Yamaha (2004, cited in Sakai, 2008) study in Japan found that following the introduction of PBU charges 79.9% of PBU communities supported the charges. It appears that experiences of PBU have increased householders' positive opinions of the system in both Ireland and Japan.

When the satisfaction level of households in Ireland following the introduction of PBU is examined in light of the international research, we see that Irish households' satisfaction with PBU is lower than that reported in the literature. It is unclear why this is the case. One possibility is that the PBU systems used in Ireland differ from those used internationally. In the international studies,

households used differential bin size charges or tag-based charges, whereas in Ireland households also use a weight-based charge. Nonetheless, the weight-based charge is not responsible for lower satisfaction levels: on the contrary, a higher percentage of households with this PBU system were in favour of PBU charges than households using a differential bin size charge. Households using a differential bin size system were less in favour of the use of PBU charges than weight or tag-based households. This is possibly because they are given less opportunities to reduce their waste costs below a certain level; once households move to the smallest bin size available to them (usually 120L) they have no way of reducing their cost further, unlike households using the other PBU systems. Another possibility for the lower satisfaction level found in Ireland may be the absence of waste charges in some areas prior to the introduction of PBU charges. Householders who, prior to PBU, used a free waste collection service are less likely to favour the charges, though this may be a reaction against paying for waste collection at all rather than PBU charges per se. As noted above, this possibility is supported by the finding that local authority customers are less positive about PBU charges than private customers. Several local authorities previously did not issue waste charges to their customers, whereas customers with private collectors have always had to pay waste charges. However, despite having a lower satisfaction rate than found in other studies, overall Irish households have accepted PBU waste charges, with 72% in favour of PBU.

PBU charges have a greater impact upon the waste management behaviour of households using a weight-based system than households using either tag or differential bin size systems, with the charges having the least impact upon differential bin size households, as experienced by the households. This is consistent with the findings of the 'impact of PBU systems on the environment' study, in the first phase of the research.

The survey showed that 91% of respondents felt that PBU charges encouraged them to recycle. A higher percentage of respondents with weight-based systems stated that their charges encourage recycling than respondents from the other PBU systems. This finding corresponds with the increased level of recycling found under weight-based systems as reported in the first phase of the research.

Of all respondents, 80% felt that PBU charges encourage them to reduce waste production. Again, a slightly higher percentage of respondents from households using weight-based systems than those using other PBU systems stated that the charge encourages waste reduction. An earlier study of weight-based PBU charges in Ireland (Scott and Watson, 2006) found that 93% of weight-based customers felt the system encourages households to reduce waste, a higher figure than found in this study (where 84% felt that their charges encourage them to reduce waste).

Ninety per cent of households stated that PBU charges have made them more aware of the cost of waste disposal. A slightly greater percentage (94%) of tag-based households felt that their charges increased cost awareness, with 90% of weight-based households and 89% of differential bin size households feeling this way. An identical percentage (90%) of households in Scott and Watson (2006) felt that their weight-based charges made them more aware of waste costs.

Fifty-one per cent felt that PBU charges increase the burden of waste disposal. This is a similar figure to that reported in Scott and Watson (2006), in which 47% felt that weight-based charges have increased the mess and bother of waste disposal.

While 69% of respondents to the household survey felt that PBU charges encourage illegal dumping, there is no evidence to support that any particular system gives

greater encouragement than any other. Furthermore, an analysis was carried out by the project team to study if there was any correlation between the type of PBU systems used in particular regions and the reported incidence to the EPA and local authorities of such activities in those areas. No such correlation was noted. However, further research into this subject would be worthwhile.

Eighty-six per cent of respondents feel that PBU increased their awareness of environmental issues.

#### 4.3.7 Households without a Waste Collection Service

Thirteen per cent of the households surveyed stated that they did not use a waste collection service. In comparison, the EPA National Waste Report 2007 found that an average of 20% of households nationally were without a domestic waste collection service.

These households were asked why they do not have a service: 69% selected not to have a service, and 31% live in an area without a waste collector operating (see [Fig. 4.3.20](#)). Using these figures, a total of 4% (31% of 13%) of households nationwide do not have access to a waste collection service. The issue of households without a waste collection service was addressed in the *Draft Statement of Waste Policy* (DoEHLG, 2010). This policy document suggests that all households should be required to use a waste collection service where it is available to them.

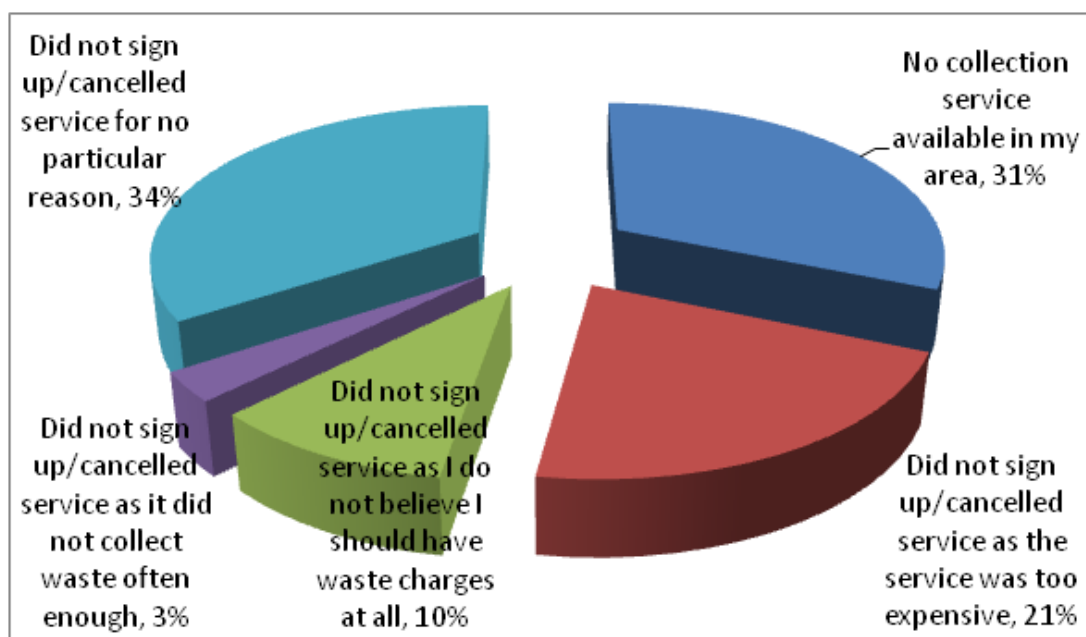
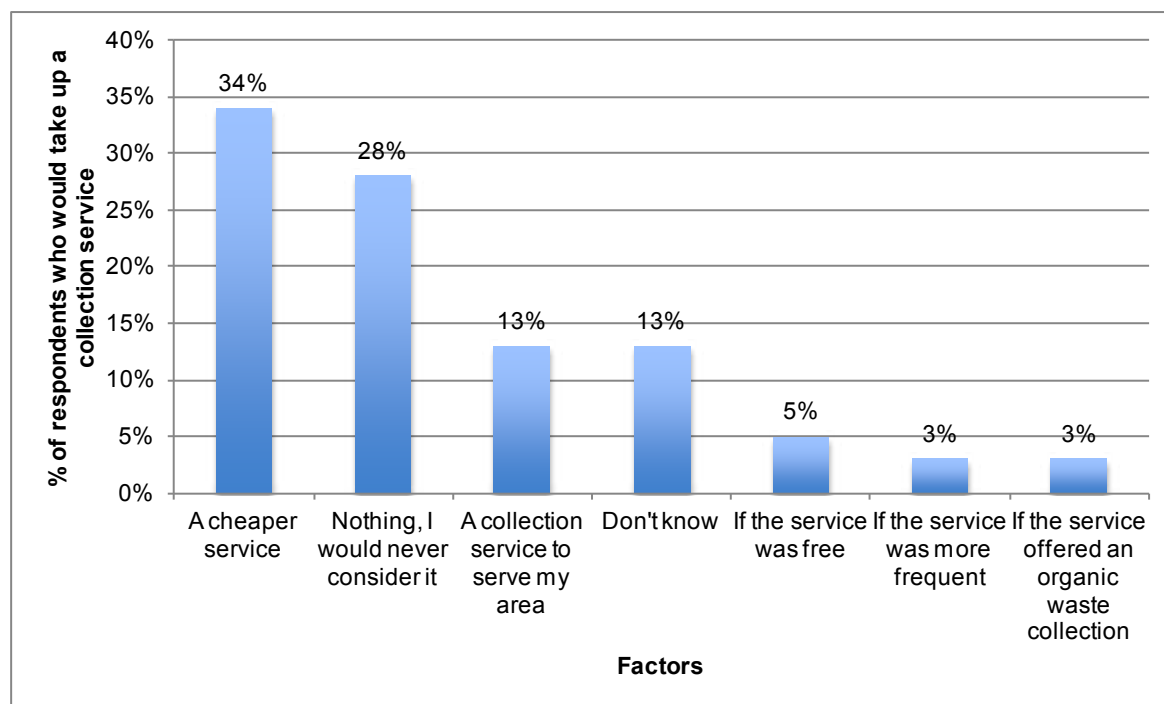


Figure 4.3.20. Reasons given by households without a waste collection service.



**Figure 4.3.21. Factors that would influence households to take up a collection service.**

Of the 69% that stated that they selected not to have a collection service, 21% of these chose not to have a service as they felt the service is too expensive, 10% selected not to have a service as they felt that they should not have to pay for waste collection, 3% opted not to have a service as they felt that the companies operating locally do collect waste frequently enough and 34% did not provide a reason.

Households without a service were asked what would encourage them to sign up to a waste collection service. The main factor that would influence households to sign up to a service is the presence of a cheaper collection service (see [Fig. 4.3.21](#)).

Households were asked how they dispose of their waste in the absence of a collection service (see [Fig. 4.3.22](#)). Use of BBs for recyclables and then disposal of residual waste through CAS or landfills are the main methods used by the households surveyed: 11% stated that they dispose of their waste illegally through fly-tipping or burning waste, 9% give their waste to another household

and 6% dispose of it in public bins. However, many more may use illegal methods but may be unwilling to cite these as their disposal methods. Further research, including a behavioural analysis of why households behave in certain ways with regard to their waste management choices should be considered. The methods of waste management cited were:

- 57% use BB to recycle;
- 42% use CAS and landfill to dispose of residual waste;
- 20% use CAS to recycle;
- 17% home compost;
- 9% burn waste;
- 9% share a bin with a neighbour/family/friends;
- 6% use public litter bins;
- 2% fly-tip;
- 3% stated that they do not know how they dispose of their waste.



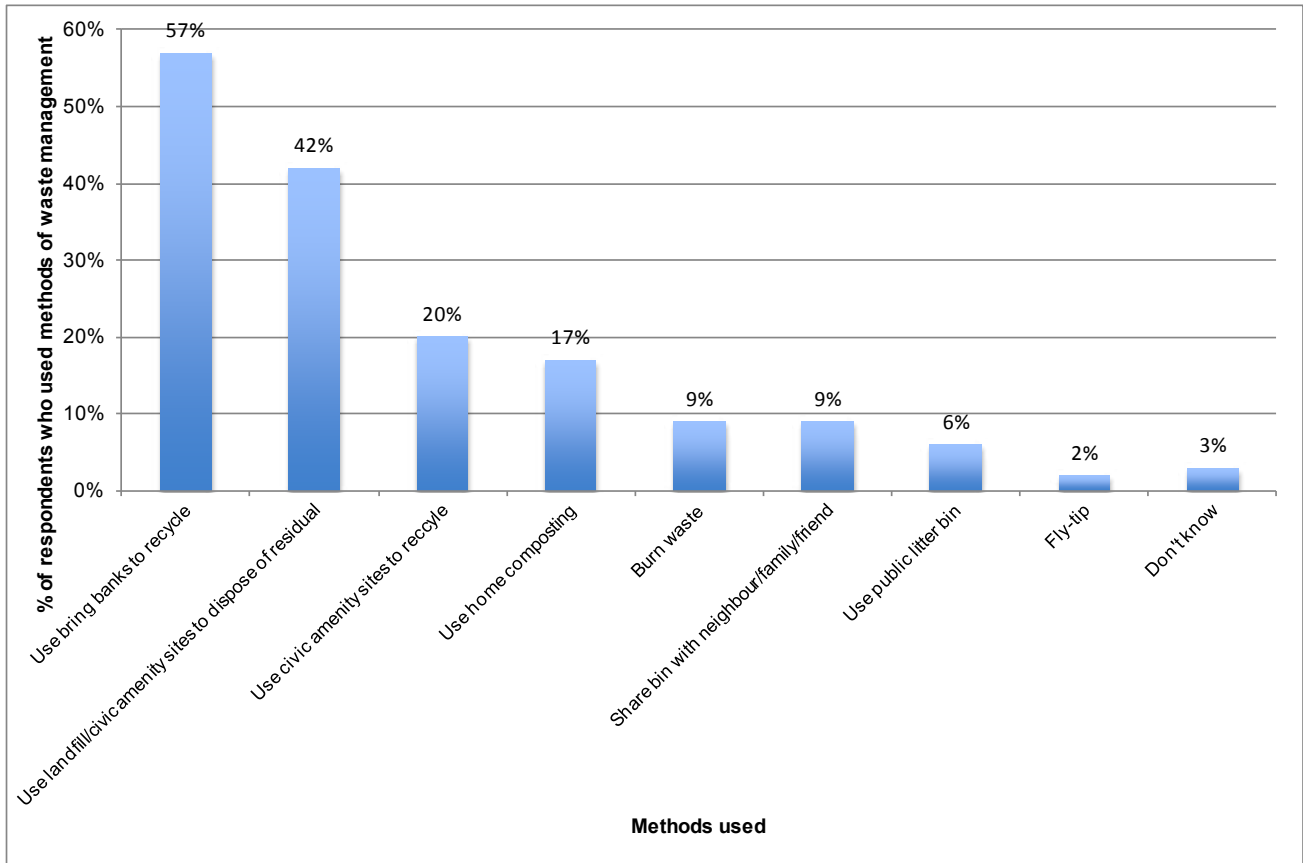


Figure 4.3.22. Methods used to dispose of waste in the absence of a waste collection service.

#### 4.3.8 Summary and Conclusions

The differential bin size system is the most commonly used system by households. Of those surveyed who gave this information, 46% stated that they use this system, followed by tag-based system households with 34%, and finally, 20% use a weight-based system.

More households use a private collector than a local authority for waste collection; 54% of households have a waste collection service operated by a private collector, and 40% use a local authority collection.

Nationally, 8% of households have a waste collection charges waiver: 14% of local authority customers and 5% of private collector customers have a waiver.

There is a high level of public acceptance of PBU domestic waste charges, with 72% stating that they are in favour of PBU. Experience of PBU charges increases positive opinion of the charge; prior to PBU

introduction 62% of households were in favour of the charges, currently 72% of households are in favour of PBU. However, households with a differential bin size system showed the least favour towards PBU charges.

The majority of householders reported that PBU waste charges have changed their waste management; 76% of householders feel PBU impacts upon their waste management behaviour, with only 20% finding these charges have little or no impact. PBU charges have most impact upon the waste management behaviour of households with weight-based charges, followed by those with tag-based charges. Differential bin charges have the least impact upon waste management behaviour.

Of respondents, 91% feel that PBU charges encourage them to recycle and 80% of respondents feel that PBU charges encourage them to reduce waste production.

A greater percentage of respondents with weight-based charges stated that PBU encourages recycling and reduced waste production than respondents with other PBU systems. Ninety per cent of respondents feel PBU charges have made them more aware of the cost of waste disposal. In addition, PBU charges may have wider consequences, as 86% of householders feel that PBU charges make them more aware of environmental issues.

Thus, householders' opinions of PBU are on the whole very positive, but there is potentially one negative outcome of the charges as 69% feel their PBU charges encourage illegal activities such as burning or fly-tipping.

Thirteen per cent of households reported that they do not have a waste collection service. There are several reasons for this: 31% of households without a waste collection service do not have a collection service available in the area, and 69% choose not to use a service. This corresponds to 4% of households nationwide without access to a waste collection service. Households without a service mainly use BB for

recycling and present residual waste direct to landfill; 11% of households without a service stated that they dispose of their waste illegally.

Four per cent of respondents said that they live in an apartment, with their waste charges included in a waste management fee. Apartment residents were in favour of PBU charges. However, apartment managers stated that apartment complexes have high levels of illegal dumping and feel PBU charges would lead to an increase in this problem.

#### **4.4 Conclusions**

All three PBU systems were publicly accepted, though weight-based and tag-based systems were favoured by householders. In addition, households using both weight-based systems and tag-based systems indicated that their PBU charges had a larger impact on their waste management behaviour than differential bin charges including recycling levels and waste reduction. Either of these two systems can be recommended for use based on the findings of the householder study.

## 5 Findings and Recommendations

### 5.1 Weight-based Pay-by-use Charges: Overall Findings

Weight-based charges are the most effective PBU system. These charges have prompted the highest per household recycling levels (between 27% and 32%), highest diversion rates from landfill (between 28% and 35%) and the lowest total kerbside waste figures (between 800kg and 947kg per annum).

Weight-based charges can thus be considered optimal on the whole from the point of view of the environment. However, when the three forms of weight-based charges are considered separately it can be seen that the 'per kilogramme' form of weight-based charging is the single most effective weight-based system, with 'banded weight' and 'average weight' systems being less effective (producing more waste and less recycling), and the 'average weight' system prompting figures similar to tag-based and differential bin size charges. In light of this finding, the research concludes that the most environmentally sustainable PBU system is the 'per kilogramme' weight-based charge.

Waste collectors using a weight-based PBU system felt that the main advantage of a weight-based system, apart from the reduction in residual waste, was the data-gathering the system allows. The system gathers accurate data on weights and frequency of presentation, which enables waste collectors to plan their collection more efficiently. In addition, weight-based charges do not encourage waste compaction in the bins, which can be a problem for some tag-based systems. The main disadvantage of weight-based charges is the expense involved in setting up the system. However, several collectors stated that the system is not expensive to run following the initial set-up costs. Another significant problem has been the use of post-service billing, which can lead to arrears (which are difficult and expensive to pursue). This problem can be overcome by the use of an advance payment system. Furthermore, households with weight-based charges present their bin frequently, even when not full, pushing up waste collection costs for collectors. The use of a lift charge alongside the weight charge can remove this problem.

Households using a weight-based system felt that their PBU charge had a large impact on their waste management behaviour, including on recycling levels and waste reduction. In addition, weight-based households expressed high levels of acceptance of PBU domestic waste charges. While 69% of respondents to the household survey feel that PBU charges encourage illegal dumping, there is no evidence to support that any particular system induces this more than any other.

Thus, weight-based charges are effective on the environmental level, and are acceptable on the social level. However, they may not be the most economically beneficial for the collector.

Using the data in [Table 4.1.4](#), and given that there are 1,469,521 households in Ireland,<sup>27</sup> these findings can be extrapolated to a national level. If the estimated 80% of those households currently on tag and differential bin systems (see [Fig. 1](#)) switched to 'per kilogramme'-based PBU systems, it could lead to an annual diversion from landfill of approximately 397,887 tonnes of domestic waste per annum through recycling, composting etc.<sup>28</sup>

### 5.2 Tag-based Pay-by-use Charges: Overall Findings

Analysis of the research indicates that tag-based PBU waste charges can be effective. Average recycling rates for tag-based charges (20%) are lower than those for overall weight-based charges (27%) and differential bin charges (21%), but average waste amounts per household are relatively low (928kg per annum) (see [Table 1](#)). However, there is a large variation in results within tag-based systems, with some collectors achieving results akin to those of weight-based

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27 <http://www.cso.ie/statistics/numprivhseholds.htm>

28 Using the following calculations: 34% of 1,469,521 households (499,637) using tag-based systems, with a difference of 128kg between this average and that for per-kg systems (928kg – 800kg) [subtotal 63,953 tonnes] plus 46% of 1,469,521 households (675,97.66) using differential bin systems, with an average difference of 1,294kg and 800kg (494kg) per household [subtotal 333,933 tonnes] = a total of 397,886.95 tonnes.

charges, while others achieve results similar to those of differential bin size charges.

For the purposes of this report, three forms of tag charges were grouped within the tag-based charge category: tag-a-bin, tag-a-bag and pay-per-lift. Each form has different advantages and disadvantages for the waste collector. A lift charge requires a large set-up cost, as the system uses chipped bins and trucks with chip-reading technology. In addition, this system involves post-service billing, which may lead to administrative costs in following up unpaid bills. This problem can be overcome by introducing an advance payment credit system, as many collectors are currently selecting to do. Tag-a-bin and tag-a-bag charges do not involve large set-up costs. However, they do entail the ongoing costs of buying tags and bags and distributing these to shops. The low cost and the upfront payment by households are the main advantages of these tag-based charges from the perspective of waste collectors. Despite these advantages, several collectors expressed the opinion that tag-a-bin and tag-a-bag systems are cumbersome and have a large administrative burden. In addition, these two systems do not allow for data-gathering by waste collectors, except when bin chips are used. Tag-a-bag has the further difficulty of broken bags leading to vermin, and this system is rarely used. Most collectors currently operating a tag-a-bin or tag-a-bag system are now moving away from these systems, towards more automated systems. A further problem with tag-a-bin and tag-a-bag has been that several collectors have operated these systems without using an annual flat charge alongside the use charge. This approach prevents waste collectors having a stable income and has not been successful, with some collectors closing their waste collection operations owing to financial difficulties.

Households had high levels of acceptance of tag-based charges, with 80% of households with tag-based systems stating they are in favour of PBU charges. More tag-based households stated that their charges made them aware of the cost of waste disposal than households using other PBU systems. In seeing a clear link between waste and cost, households are prompted to reduce the volume of residual waste they place out for collection. Waste collectors listed the inconvenience to households of buying tags as a disadvantage of the system, with one collector implementing a system

allowing credit top-up in shops, over the phone or online to combat this. The household survey indicated that households with a tag-based system did not consider that their PBU system increased the burden of waste disposal any more than households using either weight-based or differential bin sized systems.

Tag-based charges can be effective on the environmental level, and are acceptable on the social level, but collectors have indicated that there are potential problems with this system from their perspective, especially relating to the older tag-a-bin and tag-a-bag systems.

### **5.3 Differential Bin-sized Pay-by-use Charges: Overall Findings**

This PBU system was found to be the least effective system in terms of impact upon the environment, resulting in a high waste to landfill rate (79%) and highest total waste of the three PBU systems studied (1,294kg per household per annum).

There were limited discussions with waste collectors using a differential bin size system. It is widely used by private collectors, but at the time of data collection it was used by only two local authorities. One of these local authorities uses the differential bin size system exclusively and the other uses it in conjunction with tag-a-bin. A further local authority has recently begun to offer this system. Waste collectors using this charge stated that the advantage of this system is that it is easy and cheap to introduce and administer. The system involves an annual charge, paid at the beginning of the year. This charge is paid in advance of the service being provided, ensuring a stable income for waste collectors. The fee can be paid in a lump sum, thus requiring the collector to send out only one bill to each household, reducing administration costs. However, the majority of collectors now offer households the option of paying monthly or quarterly, typically by direct debit. From the perspective of waste collectors, this system appears effective. But if the system results in large amounts of residual waste being presented by householders, the waste collector can incur the cost of disposing of this at landfill.

Households with this system were less accepting of PBU (67% as compared to 79% for weight-based and 80% for tag-based systems). In addition, householders

with a differential bin size system felt that the system did not make a large impact upon their waste management behaviour, a finding that is reflected in the study of the impact of PBU systems on the environment.

Differential bin size charges are the least effective PBU system on the environmental level, and are the least acceptable on the society level, yet this system can be fully functional in terms of economy, being widely used in the private sector.

## 5.4 Other Issues and Findings

The research showed up some other issues and findings with regard to PBU systems, both relating to householders and collectors. The survey shows that approximately 53% of households surveyed said that their waste collectors are private companies and 47% are local authorities. However, it appears that the more and more people are moving to private collectors and some local authorities are deciding not to collect domestic waste any more. At the beginning of the research in 2008 there were 15 local authorities collecting domestic waste, but by 2011 this is expected to be 12 or less. In 2008 there were an estimated 80 private domestic waste collectors – this number is also expected to decrease as the industry consolidates, but the number of households served by private collectors is expected to continue to increase. This is despite the finding that PBU systems as implemented by local authorities appear to perform better environmentally than those implemented by private collectors (based upon a limited number of data sets). The weight-based systems being implemented by local authorities achieved an average 33% recycling rate and average per household waste of 768kg compared to 24% recycling and total waste of 1,040kg for those implemented by private companies. The tag-based systems implemented by local authorities achieved 21% recycling and household waste of 912kg compared to 16% and 1,192kg for those implemented by private companies.

Waste-charge waivers are provided by the majority of local authorities that collect domestic waste. These waivers reduce or waive the waste collection charge for low-income households. The topic of waivers arose as a major issue in almost all of the direct discussions with the local authority collectors, and 12 of the 15 waste-collecting local authorities provided data on this topic. Waivers were examined as part of this research as they

could influence household waste levels, lead to waste 'migration', and because they were raised as an area of concern by local authorities leading to severe financial pressures. The numbers of waivers in the different local authority areas questioned on this matter varied from 7% to 37% of customers, with an average of about 23% of local authority customers availing of a waiver. These waivers place an onerous financial burden on the local authorities and, in some cases, jeopardise their ability to continue collecting domestic waste.

The uncertainty around Irish waste policy during the research period was a concern stated by almost all waste collectors. Local authorities were unsure whether their role as waste collectors would be able to continue and were awaiting a policy statement on this topic. Until the uncertainty is resolved, most local authority waste collectors are unwilling to invest in changes to the waste management system. In addition to concerns over whether they will be allowed to continue collecting waste, local authorities were facing increasing competition from private waste collectors, which further increased uncertainty as to their future role in waste collection. Many local authorities were pessimistic about their future, with only the larger authorities showing any optimism and making plans for improvements to their services. On the other hand, the large private collectors appear more optimistic, but they too are seeking clarity regarding future waste policies before investing.

It should be noted that the *Draft Statement of Waste Policy* (DoELHG, 2010) was published for public consultation towards the end of the research period and this could have alleviated some of these concerns. This draft policy has a number of proposals, including some relating to the household waste collection market. One proposal is to move competition for the provision of household collection for local authority areas from side-by-side competition to a tendering process. Should local authorities be fully charged with responsibility for household waste collections, either directly or through procured agents, it is also proposed to introduce further measures to ensure that all householders deal with their waste in an environmentally responsible manner.

Several key components for an optimised system were identified following discussions with waste collectors. The components are those that collectors feel would improve the running of their systems from an operator perspective. These components are:

- Per-service billing;
- A reliable automated system;
- Data collection on customers.

With regard to householders, of those respondents surveyed who gave this information, 46% of households said they used differential bin-based charges, 34% said they used tag-based charges and 20% said they used weight-based charges.

All three PBU systems were publicly and widely accepted by householders. In fact, there was a widespread acceptance and approval of the concept of PBU from those who are now using such systems. Weight-based and tag-based systems were more favoured by householders according to the survey.

In addition, households using both weight-based systems and tag-based systems indicated that their PBU charges had a larger impact on their waste management behaviour than those using differential bin charges, including recycling levels and waste reduction.

## **5.5 Recommendations**

### **5.5.1 Findings and Recommendations**

- 1 The 'per kilogramme' weight-based system, and the 'pay-per-lift' tag-based system appear to be the optimised PBU systems for domestic waste collection in Ireland. These PBU systems can also provide three major components for optimisation: (i) pre-service billing, (ii) a reliable automated system and (iii) good data provision.
  - a) The 'Per kilogramme' weight-based charging is the most effective system of PBU, and it is acceptable to householders. A 'per kilogramme' weight-based system charges households directly based upon the weight of waste they place out for collection in their residual waste bin and thus implements the Polluter Pays Principle most successfully. This system is transparent to households and is considered fair when the standing charge is also perceived as being set at a reasonable level. From a waste collector perspective this system has the advantages of preventing waste compaction by householders and charging householders directly for their waste using the same measurement that waste collectors are charged by at landfill. In addition, this system provides detailed information on waste collection trends, allowing for more accurate future planning. The weight-based system can be optimised by combining a lift charge alongside the per kilogramme charge and by implementing an advance payment credit system for households, in order to counter any post-service billing problems.
- 2 Differential bin size PBU waste charges provide a less optimal option, based on the findings in terms of the environment and society.
- 3 Tag-a-bag PBU waste-charging systems are also not optimised, due, *inter alia*, to an inability to produce waste data by the collectors. Tag-a-bin systems have achieved mixed results and have led to some very negative experiences of this system from a waste collector perspective.
- 4 The waiver of domestic waste charges should be available to all those who qualify, whether from public or private collectors and the system should be standardised. However, the burden of these waiver costs should not be borne by the waste collectors alone.

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## Acronyms and Annotations

AER	Annual Environmental Report. An AER must be submitted to local authorities from all waste collection permit (WCP) and waste permit (WP) holders. This document provides details on tonnages of residual, recycling and organic waste collected, and the permit holders' number of customers.
Average weight system	The 'average weight' weight-based system uses a calculated average household waste presentation rate (commonly 800kg per year). If a household produces less weight than this average they receive a reduction on their next annual bill and if a household produces more weight than this average they are billed for the additional weight.
Banded weight system	The 'banded' weight-based system uses several weight brackets that an annual bin weight may fall within, with a different price for each weight bracket.
Black bin	The black bin is a bin which collects unmixed residual waste from householders
Brown bin	The brown bin is a bin which separately collects food and garden waste from householders
CSO	Central Statistics Office
CV	A measure of the central tendency (tight distribution) of a data set, the coefficient of variation, (CV) is the ratio of the standard deviation to the mean. A smaller value means a higher central tendency.
Differential bin system	The differential bin size charging system charges households a set fee, based on the residual bin size they select to use. Once the annual charge is paid, the householder can present their bin as often as they like, with as much waste as they like, without incurring any additional cost.
DoECLG	Department of Environment, Community and Local Government (formerly the Department of Environment, Heritage and Local Government (DoEHLG))
DoEHLG	Department of the Environment, Heritage and Local Government (now the Department of the Environment, Community and Local Government).
DRF	Dry recyclable fraction (the part of the waste that is readily recyclable and separated for separate collection for recycling). Also known as MDR or mixed dry recyclables.
EPA	Environmental Protection Agency.
Green bin	The green bin is a bin which separately collects dry recyclables from householders
Household waste	Household waste is defined as waste produced within the curtilage of a building or self-contained part of a building used for the purposes of living accommodation.
MDR	Mixed dry recyclables – the part of the waste that is readily recyclable and separated from residual waste for separate collection for recycling. Also known as DRF (dry recyclable fraction).
MSW	Municipal solid waste or municipal waste means household waste as well as commercial and other waste that, because of its nature or composition, is similar to household waste.
Organic waste	Organic waste is biodegradable food, garden and landscaping waste.
PBU	Pay-by-use (PBU) is defined as the payment of waste collection charges that relate to the amount and type of waste produced, in support of the polluter pays principle.

Pay-by-tag	The pay-by-tag-based system grouping encompasses three PBU systems: tag-a-bin, pay-per-lift and tag-a-bag. Pay-by-tag involves payment for waste collection based on the purchase of a tag and putting this tag on the bin or bag to ensure collection.
Pay-by-weight	Pay-by-weight-based systems involve payment for the waste collected, based upon its weight. Three pay-by-weight systems are currently used in Ireland: the per kilogramme system, the banded weight system and the average weight system.
Pay-per-lift	The pay-per-lift system involves a chipped bin recording the number of times it is lifted for collection and the household then receiving a regular bill charging them per bin lift.
Per kilogramme PBU system	The 'per kilogramme' system involves the use of a charge per kilogramme (kg) of MSW placed out for collection.
Polluter Pays Principle	The Polluter Pays Principle (PPP) implies that those who cause environmental damage should bear the costs of avoiding it or compensating for it and that these costs should relate to the extent and type of the damage caused.
p-value	The p-value in statistics measures consistency between the results actually obtained in a series of data and the "pure chance" explanation for those results. If the p-value is less than 0.05, then there is a true difference between the means or averages of two data sets.
Recovery	Recovery means any operation which results in waste serving a useful purpose by replacing other raw materials which would otherwise have been used - in a plant or in the wider economy.
Recycling	Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. For the purposes of this report, it generally does not include organic waste recovery systems, such as composting, but is limited to dry recyclables.
Residual waste	'Residual waste' means the fraction of collected waste remaining after a treatment or diversion step, which generally requires further treatment or disposal.
Standard deviation	In statistics, the standard deviation of a data set is the square root of its variance. Standard deviation is a widely used measure of variability or dispersion, and shows how much variation there is from the 'average' (mean, or expected/budgeted value). A low standard deviation indicates that the data points tend to be very close to the mean, whereas high standard deviation indicates that the data is spread out over a large range of values.
Tag-a-bag	The tag-a-bag system involves the purchase of a tag or sticker that is attached to a bag of waste, allowing it to be collected.
Tag-a-bin	The tag-a-bin system involves the purchase of tags, which are then attached to the bin put out for collection; bins without a tag are not collected. Bin tags vary in price according to the size of the bin used by the householder, and also whether the waste in the bin is residual waste (for disposal), organic waste or dry recyclables.
t-test	The t-test assesses whether the means of two data sets are statistically different from each other. This analysis is particularly appropriate whenever you want to compare the means of two data sets.
Waste	Waste is defined as any substance or object which the holder discards, intends to discard or is required to discard, under the new <i>Waste Framework Directive (WsFD) (Directive 2008/98/EC)</i> .

# An Ghníomhaireacht um Chaomhnú Comhshaoil

Is í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) comhlachta reachtúil a chosnaíonn an comhshaol do mhuintir na tíre go léir. Rialaímid agus déanaimid maoirsiú ar ghníomhaíochtaí a d'fhéadfadh truailliú a chruthú murach sin. Cinntímid go bhfuil eolas cruinn ann ar threochtaí comhshaoil ionas go nglactar aon chéim is gá. Is iad na príomhnithe a bhfuilimid gníomhach leo ná comhshaol na hÉireann a chosaint agus cinntiú go bhfuil forbairt inbhuanaithe.

Is comhlacht poiblí neamhspleách í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) a bunaíodh i mí Iúil 1993 faoin Acht fán nGníomhaireacht um Chaomhnú Comhshaoil 1992. Ó thaobh an Rialtais, is í an Roinn Comhshaoil, Pobal agus Rialtais Áitiúil.

## ÁR bhFREAGRACHTAÍ

### CEADÚNÚ

Bíonn ceadúnais á n-eisiúint againn i gcomhair na nithe seo a leanas chun a chinntiú nach mbíonn astuithe uathu ag cur sláinte an phobail ná an comhshaol i mbaol:

- áiseanna dramhaíola (m.sh., líonadh talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh., déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- diantalmhaíocht;
- úsáid faoi shrian agus scaoileadh smachtaithe Orgánach Géinathraithe (GMO);
- mór-áiseanna stórais peitreal;
- scardadh dramhuisce.

### FEIDHMIÚ COMHSHAOIL NÁISIÚNTA

- Stiúradh os cionn 2,000 iniúchadh agus cigireacht de áiseanna a fuair ceadúnas ón nGníomhaireacht gach bliain.
- Maoirsiú freagrachtaí cosanta comhshaoil údarás áitiúla thar sé earnáil - aer, fuaim, dramhaíl, dramhuisce agus caighdeán uisce.
- Obair le húdaráis áitiúla agus leis na Gardaí chun stop a chur le gníomhaíocht mhídhleathach dramhaíola trí chomhordú a dhéanamh ar líonra forfheidhmithe náisiúnta, díriú isteach ar chiontóirí, stiúradh fiosrúcháin agus maoirsiú leigheas na bhfadhbanna.
- An dlí a chur orthu siúd a bhriseann dlí comhshaoil agus a dhéanann dochar don chomhshaol mar thoradh ar a ngníomhaíochtaí.

### MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOIL

- Monatóireacht ar chaighdeán aer agus caighdeáin aibhneacha, locha, uiscí taoide agus uiscí talaimh; leibhéil agus sruth aibhneacha a thomhas.
- Tuairisciú neamhspleách chun cabhrú le rialtais náisiúnta agus áitiúla cinntiú a dhéanamh.

### RIALÚ ASTUITHE GÁIS CEAPTHA TEASA NA HÉIREANN

- Caimníochtú astuithe gáis ceaptha teasa na hÉireann i gcomhthéacs ár dtiomantas Kyoto.
- Cur i bhfeidhm na Treorach um Thrádáil Astuithe, a bhfuil baint aige le hos cionn 100 cuideachta atá ina mór-ghineadóirí dé-ocsaíd charbóin in Éirinn.

### TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde ar shaincheisteanna comhshaoil a chomhordú (cosúil le caighdeán aer agus uisce, athrú aeráide, bithéagsúlacht, teicneolaíochtaí comhshaoil).

### MEASÚNÚ STRAITÉISEACH COMHSHAOIL

- Ag déanamh measúnú ar thionchar phleananna agus chláracha ar chomhshaol na hÉireann (cosúil le pleananna bainistíochta dramhaíola agus forbartha).

### PLEANÁIL, OIDEACHAS AGUS TREOIR CHOMHSHAOIL

- Treoir a thabhairt don phobal agus do thionscal ar cheisteanna comhshaoil éagsúla (m.sh., iarratais ar cheadúnais, seachaint dramhaíola agus rialacháin chomhshaoil).
- Eolas níos fearr ar an gcomhshaol a scaipeadh (trí cláracha teilifíse comhshaoil agus pacáistí acmhainne do bhunscoileanna agus do mheánscoileanna).

### BAINISTÍOCHT DRAMHAÍOLA FHORGHNÍOMHACH

- Cur chun cinn seachaint agus laghdú dramhaíola trí chomhordú An Chláir Náisiúnta um Chosc Dramhaíola, lena n-áirítear cur i bhfeidhm na dTionscnamh Freagrachta Táirgeoirí.
- Cur i bhfeidhm Rialachán ar nós na treoracha maidir le Trealamh Leictreach agus Leictreonach Caite agus le Srianadh Substaintí Ghuaiseacha agus substaintí a dhéanann ídiú ar an gcrios ózóin.
- Plean Náisiúnta Bainistíochta um Dramhaíl Ghuaiseach a fhorbairt chun dramhaíl ghuaiseach a sheachaint agus a bhainistiú.

### STRUCHTÚR NA GNÍOMHAIREACHTA

Bunaíodh an Ghníomhaireacht i 1993 chun comhshaol na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstíúrthóir agus ceithre Stíúrthóir.

Tá obair na Ghníomhaireachta ar siúl trí ceithre Oifig:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig um Fhorfheidhmiúchán Comhshaoil
- An Oifig um Measúnacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáide

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag ball air agus tagann siad le chéile cúpla uair in aghaidh na bliana le plé a dhéanamh ar cheisteanna ar ábhar imní iad agus le comhairle a thabhairt don Bhord.

### **Science, Technology, Research and Innovation for the Environment (STRIVE) 2007-2013**

The Science, Technology, Research and Innovation for the Environment (STRIVE) programme covers the period 2007 to 2013.

The programme comprises three key measures: Sustainable Development, Cleaner Production and Environmental Technologies, and A Healthy Environment; together with two supporting measures: EPA Environmental Research Centre (ERC) and Capacity & Capability Building. The seven principal thematic areas for the programme are Climate Change; Waste, Resource Management and Chemicals; Water Quality and the Aquatic Environment; Air Quality, Atmospheric Deposition and Noise; Impacts on Biodiversity; Soils and Land-use; and Socio-economic Considerations. In addition, other emerging issues will be addressed as the need arises.

The funding for the programme (approximately €100 million) comes from the Environmental Research Sub-Programme of the National Development Plan (NDP), the Inter-Departmental Committee for the Strategy for Science, Technology and Innovation (IDC-SSTI); and EPA core funding and co-funding by economic sectors.

The EPA has a statutory role to co-ordinate environmental research in Ireland and is organising and administering the STRIVE programme on behalf of the Department of the Environment, Heritage and Local Government.